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BABESIASIS (PIROPLASMOSIS) AND ANAPLASMOSIS.

(477) Schellhase (W.). **Beobachtungen über die Anaplasmosis und Piroplasmosis der Schafe und Ziegen in Deutsch-Ostafrika.** [The Occurrence of Anaplasms and Piroplasms in the Sheep and Goat in German East Africa.]—*Zeitschr. f. Infektionskrankh. Parasit. Krankh. u. Hyg. d. Haust.* 1913. June. Vol. 13. No. 6. pp. 349-352.

In a previous paper (see this *Bulletin*, Vol. 1, No. 2. Abstract No. 117) the author recorded the occurrence of anaplasms in two sheep.

In the present paper he records the presence of similar bodies in the blood of two further sheep. The animals were in poor condition and the bodies were far more scanty in the blood than is observed in cattle infected with the parasite. In addition to these four animals the author has found "marginal points" in very small numbers in another batch of sheep. All the animals were in poor condition and this was the only constant symptom. In some of the cases other symptoms such as diarrhœa, rhinitis, conjunctivitis and shedding of the wool were observed, but these symptoms were not constant. Occasional "marginal points" were seen in the blood of 5 out of 18 diseased sheep.

In examining the blood of diseased sheep the author has found piroplasms resembling *P. mutans* in 6 out of 16 animals. These animals showed the same symptoms as those in which the anaplasms were found. In four of these instances both piroplasms and anaplasms were found in the same animal.

The author has also found in a few goats that were emaciated very small numbers of bodies resembling "marginal points" and piroplasms.

(478) Bevan (Ll. E. W.). **Some Observations on the different Strains of Bovine Plasmoses in South Africa and the Immunity conferred by them in Southern Rhodesia.**—*Veterinary Jl.* 1913. May. Vol. 69. No. 455. pp. 208-212.

In 1911, 48 animals received from Great Britain were inoculated with virus supplied by Theiler which contained *B. bigemina* and *A. centrale*. None of these animals died during

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the process of immunisation and reports were received regarding 38 of them after distribution. Of those reported upon 11 died and 8 suffered relapses with recovery.

During the same period 10 animals which had been inoculated at Pretoria were also inoculated with the local virus. Of these two died during the immunisation. Reports were received regarding five of the animals distributed. None of these died, and none had relapses.

These figures appear to show that the Pretoria virus does not confer complete immunity against the local virus. This was to some extent foreseen inasmuch as THEILER had found that "a recovery from infection with *A. centrale* does not cause complete immunity."

It was found that although the animals inoculated at Pretoria showed marked reactions, the virus had become markedly attenuated if not inert.

It having been found that the Pretoria virus did not confer complete immunity upon imported cattle exposed to natural infection in Southern Rhodesia, it was considered advisable again to make use of an attenuated local virus.

It was considered better that the animals should suffer from the infection while under veterinary supervision than unexpectedly after distribution.

During the year 1912-1913 seventy-seven animals from the Southern Colonies and sixty-eight from Great Britain were successfully immunised. Twenty-five home-bred animals died, but the animals were not in a suitable condition for immunising and their owners had been warned that accidents might occur.

Twenty-five animals which had been inoculated with redwater in Great Britain before shipment, and which had had more or less severe reactions, were inoculated on arrival with mixed babesiasis and anaplasmosis virus (Rhodesian), and all except two reacted to both of the infections.

Disappointing results have attended the use of trypanblue which, while controlling redwater, appears to produce a condition unfavourable to recovery from the anaplasmosis which follows. It is especially harmful in pregnant animals.

(479) CIUCA (A.). **A propos de l'Immunité Active du Chien vis-à-vis de la Piroplasmose Canine (Babesiose canine).**—*Bull. Soc. Path. Exot.* 1913. July. Vol. 6. No. 7. pp. 499-501.

A dog three months old was inoculated intraperitoneally with 16 cc. of blood containing a large number of organisms, the strain being the Tonkin virus of MATHIS. Three days later there was an elevation of temperature, and parasites appeared in the blood on the fifth day. The disease was acute and for eight days the blood was very rich in parasites. After this, parasites disappeared from the circulation and the dog recovered.

Twenty-six days after the disappearance of the parasites the blood was used for the inoculation of another dog with positive result, the dog dying on the 10th day.

Nine months after the disappearance of parasites from the blood a second dog was inoculated intraperitoneally; an acute attack was set up but the dog did not die.

Twenty-eight months after the disappearance of the parasites from the blood the intraperitoneal inoculation of 20 cc. of blood into another dog failed to produce any symptoms.

The original dog which had recovered from the acute attack following the inoculation with the Tonkin virus was then inoculated intraperitoneally with 5 cc. of defibrinated blood obtained from NUTTALL. Two days later there was a rise of temperature and parasites appeared in the blood. There was a rapid increase in the number of parasites present in the blood, jaundice and haemoglobinuria appeared, and the dog died on the 13th day after inoculation.

The author concludes that when a dog has made a complete recovery it is, at least in some cases, susceptible to fresh infection. The author "admits the identity of the parasites of MATHIS (Tonkin) and that of NUTTALL (South Africa)."

LAVERAN pointed out that dogs immune to a virus obtained from one source are not always immune to viruses obtained from other sources.

(480) ZIEMANN (H.). **Über die Kultur der Malariaparasiten und der Piroplasmen (*Piroplasma canis*) in vitro.** [The Cultivation of the Malaria Parasites and Piroplasms (*Piroplasma canis*) in vitro.]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1913. June. Vol. 17. No. 11. pp. 361-391. With 2 coloured plates.

In this abstract the cultivation of *Piroplasma canis* only is dealt with.

After many preliminary experiments the author found that it was inadvisable to obtain blood for cultures from animals that were severely infected and in whose blood parasites were numerous. The best results are obtained with blood in which the parasite has just made its appearance, and before any serious blood alterations have taken place. If dogs of more than 3 or 4 months old are alone available, the author advises that splenectomy should be performed and that about four days after they should be bled to the extent of 30 to 50 cc. of blood according to the size of the animal in order to produce a marked anaemia before they are infected. A large number of media were tried, but the best results were obtained in the following manner:

A young healthy dog is bled from the carotid into a glass cylinder with a narrow neck. The blood is carefully defibrinated, care being taken to avoid the formation of bubbles. After removal of the fibrin, 50 per cent. solution of dextrose is added in the proportion of 0·2 cc. to 10 cc. of the defibrinated blood, and in addition to this 0·3 cc. of a 2 per cent. sodium citrate in 0·85 per cent. salt solution is added to every 10 cc. of defibrinate blood. In a number of cases the sodium citrate solution did not appear to be so necessary.

The mixture is centrifuged and leucocyte-free blood is pipetted from the bottom and placed in tubes which have been filled to a height of at least 5 centimetres with inactivated (sodium citrate)-dextrose-dog-serum or (sodium citrate)-dextrose-ascitic fluid. In order to be able to work quickly fresh normal dextrose-dog-serum or dextrose-human-ascitic-fluid should be inactivated before the infected blood is withdrawn from the dog.

The author was able to obtain cultures although leucocytes were present. Inactivated human-dextrose-serum was found in some cases to be as good for cultivation purposes as the substances already mentioned. Horse serum was the worst.

The layer of corpuscles transferred to the culture tubes should not be too thin. Cultures can be obtained at 40° C. and at room temperature, but the best results were obtained at 37° C.

It is remarkable to what extent multiplication occurs within 24 hours. While dividing forms with more than four merozoites are seldom met with in the peripheral blood of dogs, in cultures there are frequently found schizonts with 16 or more merozoites. If it is desired to preserve the parasites without marked multiplication, it appears to be best to keep the tubes at room temperature. The addition of a greater proportion of dextrose does not appear to make any great difference.

The author was able to keep cultures alive for 5 or 6 days, and in one instance for 16 days. By the second day exhaustion of the medium or the formation of a toxin leads to degeneration of some of the parasites, and in any case the multiplication is most rapid during the first day.

The author succeeded in infecting dogs by intravenous inoculation with subcultures four or five days old, and in one instance he was able to obtain subcultures from a culture that was four days old. From these results it would appear that the virulence of the organism is retained in cultures. In tubes that become contaminated with bacteria the parasites rapidly die.

When degeneration occurs the parasites lose their typical morphology and become rounded. The cytoplasm stains more intensely and the chromatin less intensely. The cytoplasm may simultaneously break up into fragments.

No indication of sporogony is obtained in cultures kept at room temperature.

In two instances dogs were inoculated subcutaneously with dead cultures, but no protection against living cultures was conferred upon them.

In one instance no multiplication took place when blood from an animal that was the subject of acute piroplasmosis was added to blood taken from an apparently healthy dog which was immune to the parasite, while growth took place in control tubes containing blood from healthy dogs. As in the case of the malaria parasite, not every blood appears to be suitable for the cultivation of the parasite.

It is worthy of note that the serum of the immune dog (not inactivated) appeared to have a more rapid destructive effect upon the parasite than uninactivated serum from a normal dog.

(481) Dodd (S.). **Anaplasms or Jolly Bodies? A Contribution to the Knowledge of Certain Intracorpuscular Bodies present in the Blood of Some Species of Mammals.**—*Jl. Comp. Path. & Therap.* 1913. June. Vol. 26. No. 2. pp. 97-110. With 6 figures.

In this article are described bodies presenting morphological and staining characters identical with or very similar to those possessed by anaplasms. They have been observed in the blood of wild animals such as the lemur, mouse deer, orang-utang, capuchin monkey, etc.

Up to the present no convincing evidence has been brought forward to show whether the chromatin bodies discovered in the blood of animals, other than cattle or rodents, should be classified with the anaplasmata of Theiler or with the bodies of Jolly who first described their occurrence in the latter type of animal.

In view of the various opinions expressed by a number of authors regarding the occurrence and the nature of bodies of this kind occurring in different species, the author records the results of observations made upon nearly 300 animals of a variety of orders, excluding the domestic species.

Chromatin bodies have been observed in the mouse deer (*Tragulus javanicus*). In this animal the red corpuscles measure only 2·5 microns. The chromatin-staining bodies were found either in the marginal or in the central position, and they varied a little in size. The bodies were relatively numerous, there being one or more in every field, but no double ones were demonstrated. These bodies were only found in the blood of one out of three mouse deer examined.

Bodies possessing the same characters were found in the blood of five lemurs which died, some after having shown signs of illness and others without any illness having been observed. The marginal disposition of the bodies was noted. On account of this, blood examinations were made of eight lemurs belonging to four different species and chromatin bodies were found in variable numbers in all.

Out of 25 of the order *Quadrumana* examined by the author during the last two years chromatin bodies were found in the blood of two only.

In a capuchin monkey which had died as a result of the formation of metastatic abscesses the bodies were numerously present, but the disposition of them within the corpuscles was indifferent. There was considerable variation in size of the bodies, and none of them were seen in an extracorpuscular position. These points contra-indicate the view that they were in reality staphylococci.

In an orang-utang, the primary cause of whose death was infection with *Haemoproteus pitheci*, chromatin bodies were found in small numbers in the corpuscles from the general circulation and from the organs, but in smears made from the marrow of the long bones they were relatively numerous. In a number of the erythroblasts present in these smears the nuclei were undergoing fragmentation, and in a single smear all stages of fragmentation could be observed from the intact nucleus down to small spherical

fragments indistinguishable from the chromatin bodies. Further, in some of the corpuscles round nuclear fragments of the shape and size of the chromatin bodies could be seen just about to be detached from the parent nucleus. Cells containing nothing but small rounded bodies like those in the general circulation were common. Occasionally small dividing forms about the size of a coccus or less could be seen.

In smears from the marrow of the ribs of a hog deer (*Cervus porcinus*) a number of chromatin bodies were found in the red cells. The size of the bodies varied more considerably than those seen in the general circulation of other animals. This deer had been in the Zoological Gardens for a number of years, and up to the time of death no marked illness had been observed.

The author has observed bodies of this kind in the blood of very nearly every marsupial animal that he has examined. He has found them in animals in the best of health, wild and captive, adult and immature. Owing to this it is practically impossible to carry out any inoculation experiments. Although normally present in the blood it is legitimate to consider that their number may be increased in certain pathological conditions, such as anaemia due to stomach worms, etc. As in other species the bodies vary greatly in size.

The author's findings in the examination of the blood of a number of lemurs were practically the same as in the case of the marsupials, but as the lemur is much higher in the zoological scale the author is not prepared to admit that the conclusions drawn with regard to the bodies in the blood corpuscles of the marsupials are also to be drawn regarding the bodies found in the lemurs, although it is pointed out that according to Morris such bodies may be found in the blood of normal cats.

The chromatin bodies were present in the blood of one mouse deer only out of three that were examined, and the blood of those in which the examination was negative was examined both before and after death. It is pointed out that the red corpuscles of the mouse deer are only about one-third the size of those of the other species examined and that in them the bodies were correspondingly small. It is suggested that this is further evidence tending to show that they are in reality remains of nuclei, as it would be extraordinary to find a smaller parasite choosing for its host an animal with a smaller red corpuscle.

THEILERIASIS.

(482) Theiler (A.). **The Immunisation of Cattle against East Coast Fever.**—*Second Report of the Director of Veterinary Research. Union of South Africa. October* 1912. pp. 266-314. (1913. Cape Town: Cape Times, Ltd., Government Printers.)

In the First Report of the Director of Veterinary Research it was recorded that out of 170 animals inoculated at the laboratory in various ways, 84 survived injection and natural infection. The method was introduced on a small scale in practice and since then has been considerably extended.

Up to September 1912, 133,833 cattle had been inoculated in the Transkei with the object of protecting as many of the animals as possible, since dipping could not be resorted to.

While the work was being carried on in the field, further investigations were made in the laboratory with the object of conferring a greater immunity by inoculation. In view of the fact that quinine is a plasma poison the effect of soaking the pulp used for the inoculations in varying strengths of quinine solution for half an hour before use was investigated.

Different grains of pulp were used, as follows:—

Fine grain.—A Latapie apparatus was used for the preparation of this.

Half Medium, Medium grain.—The pulp was minced once in a "Spong" apparatus, No. 42, medium size 12 teeth, to give the medium grain, and to obtain the half-medium grain it was put through the mincer twice.

Coarse and Half-Coarse grain.—An ordinary mincing machine was used, the pulp being put through once or twice respectively.

Part I.

A. *The immunisation of cattle obtained from non-infected areas.*

Experiment 1.—Nineteen animals were injected intravenously with coarse grain spleen and gland pulp taken from an animal slaughtered in the last stages of the disease and were immediately exposed to natural infection. Of these 9 survived, *i.e.*, 47·4 per cent.

Experiment 2.—Forty animals were injected into the jugular vein with 5 cc. of coarse grain spleen and gland pulp mixed with peptone. Twelve died of the injection, 25 reacted, and 3 failed to react. Of the 28 survivors, two died of the disease when exposed to natural infection. Percentage of survivors, 65.

Experiment 3.—Forty-eight animals were injected with 5 cc. of spleen and gland pulp of various grains and exposed to natural infection 13 days later. Twenty-two or 45·8 per cent. survived.

Experiment 4.—In this experiment the conditions of the preceding experiment were repeated, save that the animals were kept for 15 days before being exposed to natural infection. Forty-two animals were used, and of these 64·3 per cent. survived.

Conclusion.—For the inoculation of cattle in a non-infected area, the experience in the field indicates that the best results are to be obtained by the injection of 5 cc. of spleen or gland pulp (medium or half coarse grain), mixed with peptone, the injected animals to be exposed to veld infection 14 to 15 days later.

B. *The immunisation of cattle in infected areas.*

Experiment 5.—To note the effect of the intravenous injection of 5 cc. spleen or gland pulp, medium grain, mixed with peptone, the animals being placed upon infected veld immediately afterwards. Twenty-four animals were used. Of these 10 survived. Of the 14 that died, four were infected previous to inoculation

and 5 died as the result of being worked while passing through the reaction. Excluding these five, the survivors numbered 52·6 per cent. The animals that were infected before inoculation are included because this is one of the factors to be expected when animals are on infected veld.

Experiment 6.—To test the effect of intravenous injections of 10 cc. of pulp mixed with peptone and aleuronat. Of 43 injected, 22 or 51·2 per cent. survived. These animals were exposed to natural infection immediately after injection.

Experiment 7.—Thirty-one animals were injected intravenously with 10 cc. of pulp mixed with peptone, and immediately afterwards turned out on infected veld. 45·2 per cent. survived.

Experiment 8.—The injection of 10 cc. of pulp mixed with aleuronat, the animals being protected from natural infection till the 10th day. Of 30 animals used in the experiment, 14, or 46·7 per cent. survived.

Experiment 9.—The intra-jugular injection of 10 cc. of coarse grain pulp, the animals being protected from natural infection till the 10th day. Forty-eight animals were used, and of these 45·8 per cent. survived. Four of these animals contracted the disease and recovered.

Experiment 10.—In this experiment the conditions of the previous experiment were repeated save that the pulp was mixed with aleuronat. Of 64 animals used, 46, or 71·9 per cent. survived.

Experiment 11.—The conditions in this experiment were the same as in Experiment 9 save that the animals were kept on a clean farm until the 14th day. Seventeen animals were used, and of these 6 survived.

Experiment 12.—In this the conditions of Experiment 10 were reproduced except that the animals were protected from natural infection till the 14th day. Thirty-three animals were used. Seven died of the disease or as a result of the injection, 2 were drowned and are therefore excluded, six died of other causes, and of the surviving 18, one died of the disease on the 62nd day. The survivors were therefore 17 out of 31, or 54·8 per cent.

Experiment 13.—The injection of 5 cc. of coarse grain pulp mixed with peptone, the animals being kept on clean ground till the 14th day. In this experiment there were 154 survivors out of 266 animals, or 57·9 per cent.

Experiment 14.—In this experiment medium and coarse grain pulp were used, mixed with peptone, or peptone and aleuronat. The injected animals were kept in a clean paddock till the 14th day. Of 109 animals injected, 72, or 66 per cent. survived.

Experiment 15.—In this experiment the dose of pulp used was 10 cc. and it was mixed with peptone. The animals were protected from infection for 14 days as before. Of the 142 animals used, 97, or 68·3 per cent. survived.

The conclusion drawn from experiments 5 to 15 is as follows:—

For the inoculation of infected herds the experience in the field indicates that the best results are to be obtained from the intra-jugular injection of 5 cc. of coarse grain spleen and gland

pulp, mixed either with aleuronat or peptone, the inoculated animals being exposed to veld infection 14 days later.

C. *Inoculation of calves.*

The calves used were from 3 weeks to 3 months old.

Experiment 16.—(*a*) Twenty-two calves were injected with 5 cc. of medium grain pulp mixed with peptone. The calves were obtained from a clean area and they remained there until the 14th day after injection. The percentage of survivors was 31·7.

(*b*) Eight calves were injected as in (*a*), but were allowed to graze on infected land immediately after. Five of the calves died, the survivors being 35 per cent.

Conclusion.—The inoculation of calves in the field indicates that the results are not likely to be so good as with full-grown animals.

D. *Double injection.*

Experiment 17.—Twenty-three animals were inoculated with a fine emulsion, and four months later the 18 survivors were injected with 10 cc. of pulp mixed with peptone. Six of these died as a result of the second injection. The percentage of animals surviving the double injection was 52·1.

Part II.

The immunisation of cattle against East Coast Fever at the Laboratory.

Experiment 18.—Two animals were injected with 5 cc. of fine grain pulp. Both reacted and survived two subsequent infestations with ticks and also natural exposure, without reaction.

Experiment 19.—In this experiment aleuronat was mixed with the fine grain pulp. Eleven animals were used. One showed the presence of plasma bodies and all survived. Six of them were tested with ticks and two died. The four survivors were submitted to natural infection and none died. The other five animals that survived injection were exposed to natural infection and two died of East Coast Fever.

Experiment 20.—In this experiment peptone was mixed with the pulp. Sixteen animals were used and one died. Of the 15 survivors 11 were tested with ticks and 5 died. The surviving six of this batch were exposed to natural infection. One died of redwater.

The four animals that were not tested with ticks were exposed to natural infection and two died, the infection being complicated with redwater in each case.

Experiment 21.—Peptone and aleuronat were together mixed with the pulp in this experiment. Five animals were injected and one died. Of the four survivors one showed plasma bodies. These four animals were exposed to natural infection and three died. Among the 3 that died was the animal that had shown plasma bodies as a result of the injection.

Experiment 22.—The pulp in this experiment was of half-medium grain, and it was injected alone, the dose being 5 cc.

Three animals were used; all survived both the injection and a subsequent exposure to natural infection. In two of the animals plasma bodies were seen after both the injection and the test.

Experiment 23.—Conditions as in Experiment 22 with the addition of peptone. Two animals were used. One died and one did not react. The animal which did not react, and which had been previously inoculated died on subsequent exposure to natural infection.

Experiment 24.—Six animals were injected intravenously with 5 cc. of medium grain pulp. Four died of the disease and one of anaemia. The remaining animal which reacted to the injection proved to be immune when exposed to infection.

Experiment 25.—In this experiment the medium grain pulp was mixed with peptone. Thirteen animals were used. Two died and five showed plasma bodies. When the whole of the survivors were exposed to natural infection four died.

Experiment 26.—The dose of medium grain pulp (5 cc.) in this experiment was added to pulverised gelatin and physiological water. Eight animals were used, and six reacted. One of these died of debility before its immunity could be tested. Two of the survivors died when exposed to natural infection.

Experiment 27.—Three animals were injected with 5 cc. of half-coarse grain pulp. All reacted and survived. They failed to contract the disease when exposed to natural infection.

Experiment 28.—The material used was similar to that in Experiment 27 with the addition of peptone. Fifty-one animals were used. Fourteen died of the disease and three from other causes. Twenty-two reacted showing plasma bodies, seven reacted but without any plasma bodies being observed, and the remaining five failed to react typically. Of the 34 survivors, one died when tested with ticks, five showed plasma bodies and recovered, and the remaining 28 survived the critical period of the test.

Experiment 29.—The following table expresses the results obtained in this experiment.

No. of animals injected.	Solution of Hydro-Quinine.	Died of East Coast Fever from Injection.	Survived Injection.	Died of East Coast Fever from tests.	Survived critical period of tests.
1	0·4 %	1	—	—	—
6	0·5 %	3	3	2	1
10	0·6 %	2	8	2	6
8	0·65 %	3	5	—	5
8	0·7 %	2	6	—	6
7	0·75 %	1	6	3	3
3	1 %	—	3	1	2
7	2 %	—	7	3	4
3	4 %	—	3	3	—
1	5 %	—	1	1	—
1	10 %	—	1	1	—
4	20 %	—	4	4	—
59	—	12	47	20	27

From this it is seen that when the strength of the quinine solution exceeded 4 per cent. there was no immunisation, and that the optimum strength appears to be about 0·6 to 0·7 per cent.

Experiment 30.—Eight animals were injected with 5 cc. of half-coarse pulp added to pulverised gelatin and physiological water. All showed plasma bodies and two died. Of the six survivors one died of the disease when exposed to natural infection.

Experiment 31.—Nine animals were injected with 5 cc. of coarse grain spleen pulp. Six died, one reacted and recovered, and the other two did not react. The one which reacted proved to be immune when tested with ticks, but succumbed to natural infection later. Of the two which did not react, one died and the other proved to be immune when exposed to natural infection.

Experiment 32.—In this experiment aleuronat was mixed with the coarse pulp. Eleven animals were injected. Six died, and of the remaining five, two developed the disease but recovered when subsequently tested, and the remainder were immune.

Experiment 33.—Of 5 animals injected with 10 cc. of coarse grain pulp mixed with aleuronat, all survived. Three died of East Coast fever when tested with ticks, and the other two survived tick infestation and exposure to natural infection.

Experiment 34.—Eleven animals injected with 5 cc. of pulp mixed with peptone. Six reacted, and of these 3 died. Two of these were found to be immune to tick infestation, but one contracted the disease naturally and recovered. Of the six animals remaining, one died, one had a reaction, and the rest were found to be immune when exposed to natural infection.

Experiment 35.—Five animals were injected with 10 cc. of pulp mixed with peptone. Two died, and the remainder were found to be immune both to tick infestation and to natural infection.

Experiment 36.—In this experiment the conditions obtaining in Experiment 34 were repeated with the exception that aleuronat was added as well as peptone. Five animals were used. Three reacted to the injection and two died. Of the three survivors two died on exposure to natural infection.

Experiment 37.—In this experiment the animals were given two injections of pulp. In some instances the pulp was given pure, while in others it was mixed with peptone or aleuronat. The intervals elapsing between the injections varied from about three weeks to two and a half months. In one instance the pulp used for the first injection was saturated in a 10 per cent. solution of quinine.

Twelve animals were used. In four cases there was no reaction. In two cases there was a reaction with the discovery of plasma bodies, but the animals recovered. In the remaining cases there was a reaction and the animals recovered. Only one animal died when exposed to natural infection, although several reacted.

Experiment 38.—Twenty-five animals were injected on two occasions with 5 cc. of pulp mixed with peptone and varying strengths of quinine solution. Twelve died of the disease.

Of the 13 survivors, six died when submitted to the immunity test, but as is shown in a table, all these six animals which had not acquired immunity from the injection, had received pulp which had been soaked in hydro-quinine of from 10 to 40 per cent. strength.

Experiment 39.—Twenty-five animals were injected on three occasions with 5 cc. of pulp of varying grains and in varying mixtures. Two died from the injection and 18 proved to be immune when tested.

The following conclusions are drawn:—

"1. The experience in the field indicates that the inoculation can safely be undertaken in respect of either clean or infected cattle with the prospect of conferring immunity on 50-60 per cent.

"2. The best results in the field may be expected by the injection of 5 cc. of spleen and gland pulp (medium, half-coarse, or coarse grain) mixed with Peptone or Aleuronat, such animals to be kept on clean veld for 14 or 15 days before they are exposed to natural infection.

"3. The immunity conferred by the injection may not be absolute, inasmuch as 12 breakdowns were noted among the experimental animals, or 1 per cent.

"4. The animal which supplied the spleen and gland pulp for the injection has apparently an influence on the results, as the variation in mortality from the injection cannot be considered to be due to any other factor.

"5. As a possible improvement to the present method of immunising cattle against East Coast fever, the saturation of the pulp in a solution of Quinine Hydrochloride is suggested, the strength of the solution to be between 0·6 and 0·7 per cent."

TRYPANOSOMIASIS.

(483) Bruce (D.), Harvey (D.), Hamerton (A. E.), & Lady Bruce. **Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. The Wild-game Strain.** —*Proc. Roy. Soc.* 1913. June 12. Series B. Vol. 86. No. B 589. pp. 394-407. With 7 charts.

The trypanosomes used in the investigations described in this paper were isolated by inoculation of blood from a reedbuck, a waterbuck, an oribi, and two hartebeeste. Measurements were taken of 500 trypanosomes in the blood of rats inoculated with the five strains.

The charts obtained closely resembled each other and also those obtained from some of the human strains described in a previous paper.

The following conclusions are drawn:—

"1. The five Wild-game strains resemble each other closely, and all belong to the same species of trypanosome.

"2. The Wild-game strains and the Human strains, although they differ to some extent, also belong to the same species.

"3. This species is *T. rhodesiense* (Stephens and Fantham).

"4. There is some reason for the belief that *T. rhodesiense* and *T. brucei* (Plimmer and Bradford) are one and the same species."

(484) Bruce (D.), Harvey (D.), Hamerton (A. E.), & Lady Bruce. **Morphology of various Strains of the Trypanosome causing Disease in Man in Nyasaland. The Wild *Glossina morsitans* Strain.** — *Proc. Roy. Soc.* 1913. June 12. Series B. Vol. 86. No. B 589. pp. 408-421. With 7 charts.

The strains from which the charts given in this paper were constructed were obtained from wild flies, and the trypanosomes were isolated by feeding the flies on a number of animals, the trypanosomes being then inoculated into rats, these being solely used for the measurements.

As in the case of the wild-game strains 500 individuals of each strain were measured.

Superposed charts of the Wild-game strain, the Wild-fly strain and the Human strain shew that the last of these differs to a considerable extent from the other two, which closely resemble each other. But it was found that the form of the chart was the only thing which supported the idea that the trypanosomes might not be identical, every other factor indicating identity.

The conclusions are as follows:—

"1. The five Wild *Glossina morsitans* strains resemble each other closely, and all belong to the same species of trypanosome.

"2. The Wild *Glossina morsitans* strain, the Human strain, and the Wild-game strain, belong to the same species.

"3. This species is *T. rhodesiense* (Stephens and Fantham).

"4. It is probable that *T. rhodesiense* and *T. brucei* (Plimmer and Bradford) are identical."

(485) Kinghorn (A.), Yorke (W.), & Lloyd (Ll.). **Final Report of the Luangwa Sleeping Sickness Commission of the British South Africa Company, 1911-1912.** — *Ann. Trop. Med. & Parasit.* 1913. June 10. Vol. 7. No. 2. pp. 183-302. With 12 plates.

The matter contained in this Report is divided into six sections as follows: The Human Trypanosome; Trypanosomes of Game and Domestic Stock; Trypanosomes in Wild *Glossina morsitans;* Description of the Trypanosomes; Development of *Trypanosoma rhodesiense* in *Glossina morsitans;* and the Report of the Entomologist. Two appendices contain a description of an experiment to ascertain whether Tabanids transmit trypanosomes in nature, and an account of an attempt to transmit *Trypanosoma rhodesiense* by means of *Ornithodorus moubata.*

Much of the matter contained in the report has already been published in the form of separate papers.

The following is the summary of the section dealing with the human trypanosome:

"1. The human trypanosome (*T. rhodesiense*) is distributed widely throughout South Central Africa.

"2. There is no essential difference between the clinical manifestations of the disease in man caused by *T. rhodesiense* and that due to *T. gambiense*, except possibly the greater virulence of the former.

"3. *T. rhodesiense* is transmitted in Rhodesia by *Glossina morsitans.*

"4. Approximately 3·5 per cent. of the flies may become permanently infected and capable of transmitting the virus.

"5. The period which elapses between the infecting feed of the flies and the date on which they become infective varies from eleven to twenty-five days in the Luangwa Valley.

"6. Attempts carried out at laboratory temperature on the Congo-Zambesi plateau during the cold season to transmit the human trypanosome by means of *Glossina morsitans* were invariably unsuccessful in spite of the fact that 680 flies were used in these experiments.

"7. The developmental cycle of *T. rhodesiense* in *Glossina morsitans* is to a marked degree influenced by the temperature to which the flies are subjected. High temperatures (75°–80° F.) favour the development of the parasite, whilst low temperatures (60°–70° F.) are unfavourable.

"8. The first portion of the developmental cycle can proceed at the lower temperatures, but for its completion the higher temperatures are essential.

"9. The parasites may persist in the fly at an incomplete stage of their development for at least sixty days under unfavourable climatic conditions.

"10. These observations afford an adequate explanation of the extremely long latent periods of trypanosomes in Glossina which have occasionally been observed by various workers.

"11. The relative humidity of the atmosphere has apparently no influence on the development of the trypanosome in *Glossina morsitans*.

"12. Mechanical transmission does not occur if a period of twenty-four hours has elapsed since the infecting meal.

"13. *Glossina morsitans*, in nature, has been found to transmit the human trypanosome.

"14. The chief reservoir of the human trypanosome is the antelope.

"15. The results of examination for the human trypanosome of the blood of a large number of monkeys, wild rats and mice were invariably negative."

It is estimated that the percentage of big game infected with trypanosomes pathogenic to man and domestic stock in the Luangwa Valley may be placed at 50, and on the Congo-Zambesi watershed at 35.

In the Luangwa Valley six species of trypanosomes were isolated from game and stock, viz., *T. rhodesiense*, *T. vivax*, *T. nanum*, *T. pecorum*, *T. montgomeryi*, and *T. multiforme*. On the Congo-Zambesi watershed the following trypanosomes were isolated: *T. rhodesiense*, *T. vivax*, *T. nanum*, *T. pecorum*, and *T. tragelaphi*.

In the Luangwa Valley *T. rhodesiense*, *T. pecorum*, and a third parasite termed by the authors *T. ignotum* were isolated from wild *Glossina morsitans*. In a foot-note to a subsequent section it is stated that *T. ignotum* is probably identical with the organism described by the Sleeping Sickness Commission of the Royal Society and named *T. simiae*, this name claiming priority should the two prove to be identical.

In the fourth section of the report is given a description of the trypanosomes encountered by the Commission, and it is perhaps convenient to include a brief summary of the section.

Trypanosoma rhodesiense having been dealt with at length in the first section of the report, it is not further described save to mention the varieties of animals from which it was isolated.

T. vivax.—This organism is principally characterised in the living state by its extraordinary rapidity of movement.

In stained preparations it is more or less club-shaped with a long free flagellum. The nucleus is placed about the centre in the body. The blepharoplast is large and rounded, and lies close to the posterior end of the body. The undulating membrane is poorly developed or nearly absent. The average length is 23·6 microns, with a maximum of 28·75 and a minimum of 18·75. The average breadth is 3·2 microns.

In a small number of experiments monkeys, rabbits and rats were found to be insusceptible.

Although it could not be definitely proved that this trypanosome is transmitted by *G. morsitans* in nature, owing to the lack of suitable experimental animals, it was proved experimentally in two cases that the fly is capable of transmitting the parasite.

T. nanum.—A short sluggish organism with no progressive motion.

In stained preparations the posterior extremity of the body is rounded, and the blepharoplast which is small is placed quite close to it. There is no free flagellum and the membrane is poorly developed. The protoplasm is free from granules and vacuoles. The length varies from 19 to 10 microns with an average of 14·3. The average breadth is 1·5 microns. Monkeys, rats and one rabbit were found to be insusceptible.

T. pecorum.—It is stated that owing to the lack of suitable experimental animals this trypanosome could not be distinguished with certainty from the preceding and its morphological characters are practically the same.

While the transmitting agent of *T. nanum* could not be ascertained with certainty, it was proved that *G. morsitans* transmits *T. pecorum* in nature.

T. multiforme, n. sp.—This organism was isolated from a bushbuck at Nawalia. It is remarkably polymorphic and variations of motility are observed, the short sluggish ones showing no tendency to alter their position, while the long forms which are provided with a free flagellum shew marked translatory movement. The maximum length is 33·5 and the minimum 10·5 microns. The organism is said to resemble *T. gambiense* more closely than any other species. Monkeys, rabbits, and rats were found to be susceptible, the guinea-pig proving refractory. The infection in laboratory animals runs a very chronic course. The transmitting agent is unknown.

T. montgomeryi(?).—Found in one dog only on the Nyasaland border. The organism is broad and stumpy, and shows no marked translatory power. The greater breadth of the parasite serves to distinguish it from *T. pecorum*. The blepharoplast lies quite close to the posterior extremity and sometimes projects slightly from the surface. Membrane very poorly developed and there is generally no free flagellum. The posterior portion of the body often contains large vacuoles, and granules may be found scattered through the whole of the cytoplasm. The maximum length is 20 and the minimum 10 microns. The breadth varies from 1·25 to 6·5 microns.

Nothing is known regarding either the pathogenicity or transmission of the organism.

T. ignotum (probably identical with *T. simiae*). A comparatively short slender organism which is fairly actively motile, but with little power of translation.

The posterior extremity is generally rounded and the blepharoplast which is small sometimes projects from the surface. The membrane and flagellum are poorly developed, and there are generally no granules or vacuoles in the body. The maximum length is 23 and the minimum 12 microns.

The organism was isolated from wild *Glossina morsitans*, but it has never been found in wild game. Monkeys were found to be very susceptible, death taking place in from 5 to 16 days. Rats, guinea-pigs, mice, cattle, and dogs failed to become infected. In a goat the trypanosome was once seen, but the animal survived. Rabbits could be infected, but the disease did not as a rule run a rapid course, two surviving over a hundred days.

The percentage of infective flies was found to be not less than 0·3 per cent., and in one instance evidence was obtained that development of the trypanosome occurs in the proboscis.

T. tragelaphi.—Closely resembles *T. ingens*, but appears to be rather shorter and more slender. The possibility is suggested that leeches or mosquitoes may be the transmitting agents.

Section V. of the report deals with the development of *T. rhodesiense* in *Glossina morsitans*.

Section VI. comprises the report of the Entomologist and deals with (*a*) *Glossina morsitans* in the laboratory, (*b*) A record of some breeding places of *Glossina morsitans*, (*c*) A record of blood-sucking insects and ticks collected in the Luangwa Valley and at Ngoa. In collections of *Glossina morsitans* made without discrimination the proportion of females was often found to be as low as 2 per cent., although it was found that taking into consideration a period of twelve months males and females emerged from the pupae in about equal proportions. In the latter half of the year the males slightly predominated, while in the earlier half of the year the reverse was the case. The period of pupation varied from 21 to 88 days, depending to a great extent on the temperature. The shortest periods were observed at a temperature of 86° F. and the longest at 62° F. Very high or very low temperatures were found to have a deleterious effect.

A description illustrated by a number of photographs is given of places in which Glossina was found to have bred. In most cases the positions were such that they received sunshine for a number of hours daily. The pupae were nearly always lightly covered with earth.

The following blood-sucking insects and ticks were found: Ixodoidea, *Ornithodorus moubata*. Tabanidae, *T. africanus*, *T. biguttatus*, *T. par*, *T. liventipes*, *T. nigrostriatus*, *T. taeniola*, *T. taeniola* var. *variatus*, *T. fraternus*, *T. fuscipes*, *T. albipalpus*, *T. pullulus*, *T. claritibialis*, *T. atrimanus*, *T. copemani*, *T. diversus*, and *T. maculatissimus*. In addition to these, five other species were collected but have not yet been identified.

Haematopota were very rarely encountered as compared with the foregoing and the following species have been identified: *H. mactans, H. insidiatrix, H. sp.* (undescribed). Muscidae, Glossina—the only species collected was *G. morsitans.*

Auchmeromyia luteola was commonly found. *Cordylobia anthropophaga* was encountered. A few specimens of *Stomoxys nigra* were found and *Stomoxys calcitrans* was very numerous at times. Pupipara, *Hippobosca hirsuta* was repeatedly found. Two other species of Hippobosca, one wingless and the other winged were taken, the former on several occasions, and the latter only once.

In an appendix to the report is given an account of an experiment undertaken to ascertain whether tabanids transmit trypanosomes in nature. The flies were placed, as they were caught, on a monkey, but only a small proportion fed. All that fed were dissected and examined, and only seven out of the total number—128—were found to contain flagellates; these were present in the mid and hind gut only. Inoculations were made into wild rats on four occasions, but in only two of these instances did the rats survive sufficiently long to allow of conclusions being drawn, and these remained negative.

In a second appendix a brief account is given of an experiment carried out with the object of transmitting *T. rhodesiense* by means of *O. moubata.* The experiment failed entirely.

For abstracts of portions of this report published as separate papers see this *Bulletin,* Vol. 1, pp. 78, 79, 95, 149, 155, and 156.

(486) Wenyon (C. M.) & Hanschell (H. M.). **A further Note on *Trypanosoma rhodesiense* from Three Cases of Human Trypanosomiasis.**—*Jl. London School Trop. Med.* 1913. April. Vol. 2. No. 2. pp. 123-128.

The observations recorded in this paper were made with particular reference to the occurrence of posterior-nuclear forms, the constancy of their presence in the blood of white rats, their percentage and variation, and the relationship between the virulence and the percentage of posterior-nuclear forms.

The strains were obtained from three cases of infection in the human subject, in none of which were any trypanosomes with the posterior disposition of the nucleus seen. Such trypanosomes were observed in the first rat of each series inoculated from the patients. In each series of rats subinoculated with the strains there were days on which posterior-nuclear forms were absent, and in one rat none were seen during the twelve days that it lived. As a rule the posterior-nuclear forms were observed in the broad trypanosomes, but they were also observed in the long slender forms.

Although the number of observations was too small to allow of definite conclusions being based upon them, the authors got the impression that posterior-nuclear forms were more numerous in the first passages in the rats, and in some cases the proportion of these forms appeared to increase in proportion to the length of the rat's life, but there were numerous exceptions.

No correlation could be established between the number of posterior-nuclear trypanosomes and the virulence of the strains.

In connection with the importance of the posterior-nuclear forms the following paragraphs may be quoted:

"It has been noted that these forms are known to occur in *T. pecaudi* (Soudan) and *T. brucei* (Uganda).

"Recently STEPHENS and BLACKLOCK have expressed the belief that *T. brucei* of Uganda is not the same species as *T. brucei* of Zululand, the original source of the type species of PLIMMER and BRADFORD. They base their belief on the fact that *T. brucei* (Zululand) is a constant monomorphic trypanosome, while *T. brucei* (Uganda) is a markedly polymorphic one—in this resembling *T. pecaudi* and *T. rhodesiense*.

"If this be so, it will probably be found, as some have maintained, that the Uganda *T. brucei* is the same as *T. pecaudi* of the Soudan. The trypanosome of Uganda hitherto known as *T. brucei* would therefore have to be called *T. pecaudi*. Further, there seems to be an accumulating amount of evidence in favour of regarding *T. rhodesiense* as identical with *T. brucei* of Uganda. If this turns out to be correct, then the specific name *rhodesiense* will have to give place to the name *pecaudi*."

(487) BEVAN (Ll. E. W.). **Preliminary Note on a Trypanosome causing Disease in Man and Animals in the Sebungwe District of Southern Rhodesia.** — *Jl. Trop. Med. & Hyg.* 1913. April 15. Vol. 16. No. 8. pp. 113-117. With 2 plates and 7 temperature charts.

The strains used in the observations recorded in this paper were obtained from a man, a dog, and a goat, two rabbits being inoculated from each strain. From the examination of moist and stained preparations taken from the first passage rabbit in each case it appeared that the trypanosomes were identical. In each case long, short and intermediate form were observed, these gradually merging into each other.

The trypanosomes appeared to correspond very closely with *T. rhodesiense*. The animals inoculated did not show the oedema of the head that characterised the infection produced by the trypanosome obtained from 'W. A.'

A further report is to be published regarding the trypanosomes found in two of the experimental rabbits.

(488) LAVERAN (A.). **Au Sujet du *Trypanosoma rhodesiense* et du *Trypanosoma brucei*.—*Bull. Soc. Path. Exot.*** 1913. May. Vol. 6. No. 5. pp. 340-343.

In this paper brief references are made to the various views that have been expressed by different authors regarding the identity of these two trypanosomes and the evidence that has been considered in arriving at the different opinions. Among other points referred to is the question as to whether the *T. brucei*, Uganda, is identical with *T. brucei* (PLIMMER and BRADFORD).

Laveran is of the opinion that further proof must be furnished before it can be considered as certain that *T. rhodesiense* and *T. brucei* (Uganda) are identical, and suggests that cross-immunity experiments would furnish the most valuable evidence.

(489) Shilston (A. W.). **Notes on Zululand Trypanosomes.**—*Second Report of the Director of Veterinary Research, Union of South Africa. October,* 1912. pp. 345-361. With 2 plates. (1913. Cape Town: Cape Times, Ltd., Government Printers.)

After discussing at some length the question of the identity of the different strains of trypanosomes known as *T. brucei*, the author proceeds to the description of a trypanosome isolated from a mule in Zululand.

Towards the end of 1911 blood smears made from a beast and from a donkey were found to contain small trypanosomes, but the infected animals died before it was possible to make sub-inoculations. Later, in the hope of obtaining this trypanosome a dog was inoculated with the blood of a sick mule. This dog shewed trypanosomes in its blood six days after inoculation. On making an examination of smears from this animal it was found that it was not the small trypanosome that was present, but an organism in which a considerable proportion of individuals were furnished with a well-marked free flagellum. It seemed probable that the disease was nagana. Further examination shewed that it resembled far more closely the strain known as the Uganda *T. brucei*. A number of charts drawn up according to Bruce's plan are given, and these shew very marked differences, but no great importance can be attached to them as they have not been constructed upon the examination of a very large number of organisms, nor have they been made methodically with regard to the period of infection, etc.

The author draws the following conclusions:—

1. That a trypanosome occurs in animals in Zululand, which is markedly dimorphic, and in this and other respects closely resembles the trypanosome described by Sir David Bruce and others as *Trypanosoma brucei*.

2. That the trypanosome introduced into Europe in 1896 and described by various authorities as *Trypanosoma brucei*, differs to a marked degree from that described under the same name by Bruce, and from the Zululand trypanosome described in the present paper.

3. That a careful study of the trypanosomiases of Zululand is necessary to determine, among other things, whether a trypanosome having the characters of *T. brucei* as formerly described, also exists in that country.

Notes on a small trypanosome from Zululand.

The small trypanosome referred to in the preceding note has been frequently observed in blood smears from widely different sources, but it has not been possible as yet to obtain a strain for accurate study. The organism has been observed in the blood of oxen and donkeys.

In preparations fixed in alcohol and stained with Giemsa the maximum length is 13 microns and the minimum 9. The breadth varies from 1·5 to 2·5 microns. The body of the parasite is short and stout. The posterior extremity is rounded and the anterior tapering. A few chromatin granules may be present in the anterior portion of the body, but frequently the cytoplasm stains uniformly. The nucleus is of a rather elongated oval shape, and situated about the centre of the body. The micronucleus is round and placed close to the posterior extremity. The undulating membrane is not well developed and there is no free flagellum.

Since no animal inoculations have been carried out as yet, it is impossible to make any definite pronouncement as to the identity of the organism, but it appears to resemble *T. pecorum* very closely. The fact that it has been found in donkeys excludes *T. nanum*, and *T. uniforme* would appear to be excluded by its greater average length, 16 microns.

(490) Rondoni (P.) & Goretti (G.). **Richerche sperimentali sul Nagana. I. Communicazione. Su alcune Proprietà Biologiche della Milza nella Infezione sperimentale da** *Trypanosoma brucei*. [Experimental Researches on Nagana.]—*Lo Sperimentale*. 1913. April 7. Vol. 67. No. 1. pp. 1-24.

This paper contains a detailed account of experiments which were carried out by the authors to ascertain whether trypanocidal substances and specific antibodies are formed in the spleen during infection, and also to investigate the haemolytic powers of spleen extract.

The general conclusions arrived at are:—

The spleen of animals (guinea-pigs and rats) infected with *T. brucei* sometimes contains trypanolytic substances; this organ appearing to play a special part in the defence of the organism.

Aqueous extracts of the spleen of infected animals were found to possess a haemolytic power for red corpuscles obtained from any source, and even from the same individual. The substances can be extracted with alcohol and they behave in different manners when subjected to heat. Normal serum appears, at least in part, to exert an inhibiting effect. They are probably of a lipoid nature and seem to be of very little vital importance.

(491) Martoglio (F.). **Sulle Tripanosomiasi del Dromedario Eritreo.** [Trypanosomiasis of the Dromedary in Eritrea.]—*Annali d'Igiene Sperimentale*. 1913. Vol. 23. No. 2. pp. 229-234. With 2 text-figures.

There are two trypanosomes to which the dromedary is susceptible. One of these is also the cause of a disease in bovines, which is termed "giahan" and the other which is common to the ox, horse and sheep is responsible for the disease known as "atteh," and belongs to the surra group of trypanosomes.

The trypanosomes are distinguishable by the following characters:—"Giahan" is transmitted by Stomoxys, while "atteh" is transmitted by Tabanidae. The two organisms are morphologically distinguishable. That causing "giahan" appears to be dimorphic, as it is said that young forms measure from 14 to 16 microns and adult forms 24 microns including the flagellum. The parasite of "atteh" measures about 30 microns excluding the flagellum, which measures about 8 microns. The parasite of "giahan" is not pathogenic for the dog, rabbit, mouse, whilst that causing "atteh" is pathogenic for these animals. The parasite of "atteh" has little or no pathogenic power for the adult ox and the sheep, while that of "giahan" is markedly pathogenic for these animals.

(492) Kohl-Yakimoff (Nina), Yakimoff (W. L.), & Bekensky. **Le Trypanosome des Bovidés (*Tr. theileri* ou du Type voisin) en Russie d'Europe.** [The Trypanosome of Cattle (*Theileri* or a similar Type) in Russia in Europe.]—*Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. pp. 433-434.

The authors have examined the blood of 14 animals without finding flagellates by microscopic examination, but by employing Sergent's method have been able to obtain cultures of flagellates from 5 of them. They have been able to pass the strain on from the broth to NNN medium and keep it for several generations. They have also been able to inoculate a calf successfully.

(493) Kohl-Yakimoff (Nina), Yakimoff (W. L.), & Schokhor (N. J.).—**Le Trypanosome des Bovidés (*Tr. theileri* ou du Type Voisin) au Turkestan.** [Trypanosome (of the *Theileri* or allied Type) in cattle in Turkestan.]—*Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. p. 434.

The authors have obtained cultures of the trypanosome from the blood of cattle in eight cases out of nine examined. The cattle in Turkestan are said to be very frequently infected with *Theileria* (*Piroplasma*) *mutans*.

(494) Fry (W. B.) & Ranken (H. S.). **Further Researches on the Extrusion of Granules by Trypanosomes and on their further Development.** (With a Note on Methods by H. G. Plimmer.) —*Proc. Roy. Soc.* 1913. June 12. Series B. Vol. 86. No. B. 589. pp. 377-393. With 3 plates.

Two methods were principally used in the earlier part of the investigations described in this paper. These were dark-ground illumination and vital staining with a 0·75 per cent. solution of toluidine blue in physiological salt solution. Other methods have been devised and these are described at some length.

Two types of granules are described as occurring in the bodies of trypanosomes, namely, reserve food granules and the special granules which are the subject of this communication. The latter granules are of nuclear origin and are infective.

These infective granules have been found in *T. gambiense*, *T. rhodesiense*, *T. brucei*, *T. evansi*, *T. nanum*, *T. pecaudi*, and *T. lewisi*.

When examined with dark-ground illumination the granule appears as a small, sharply-defined, highly refractile body, and with vital staining it takes up the stain rapidly and acquires an intense colour.

The number of granules varies in different species of trypanosomes, and the number and size of granules present in any species are inconstant. It was observed in the case of *T. nanum* carried on in gerbils, that the granules increased in number but decreased in size as the virulence of the trypanosome increased.

The authors have found that granules are not always necessarily present in trypanosomes, nor have they been able to determine what conditions are necessary for their formation, but they are able to indicate at what stage they make their appearance.

It was observed that when trypanosomes first made their appearance in the blood they did not contain granules. After about the fourth day granules were to be observed in the trypanosome bodies and for about 24 hours trypanosomes containing granules were numerous. After this period when free granules were numerous in the blood the proportion of trypanosomes containing granules decreased until, finally, although the trypanosomes might be enormously numerous in the blood, none of them contained granules.

This was found to hold good for *T. brucei*, *T. nanum*, and *T. evansi*.

The original observations regarding the extrusion of granules have been confirmed and the process has been followed with *T. nanum* and *T. gambiense*. The former is very suitable for the purpose as the granules are large and the trypanosome does not execute any marked translatory movements.

When extrusion of a granule is about to take place it passes from the centre of the body towards the pointed end and then makes its way back again to the centre. This may occur a number of times, the granule being finally extruded from the pointed extremity.

In *T. gambiense* the granules are multiple and extrusion does not occur at the pointed extremity but from a point near the middle of the body.

Extrusion is most readily observed in infections running an acute course.

The extrusion of the granules may be stimulated by drugs, and when trypanosomes are killed by trypanocidal agents the granules are not necessarily killed but make their escape from the degenerating bodies.

There appear to be three methods by which granules may make their escape. They may be forcibly extruded by the activity of the trypanosome; by active movement of the granule in a rapidly degenerating trypanosome; and by outside agencies such as currents breaking up degenerating trypanosomes and allowing granules which cannot escape by their own movements to be liberated.

Changes of osmotic pressure also have effects upon the liberation of the granules.

With vital staining free granules take the stain rapidly and uniformly. For a short time the freed granule remains stationary near the parent trypanosome, but then shows independent movement, passing across the field with a rolling motion. The authors believe that a pseudopodial process makes its appearance.

The free granules are to be found in the blood, glands, and internal organs. They have been found in the proximal glands in experimental animals 24 hours after infection.

In a foot-note by PLIMMER it is stated that the motility of the granules can be demonstrated by the addition of a little cherry-gum to a preparation as this stops all Brownian movement while it only slows the true motility, and their affinity for toluidine blue assists in distinguishing them from other particles such as blood platelets.

The subsequent stages of development of the granules are more difficult to follow as they cannot be seen in any individual preparation, and consequently the authors are not in a position to state definitely that they have arranged the changes observed in the correct chronological order.

Granules have been observed to have been ingested by leucocytes, and older granules have been observed in the interior of endothelial and other cells, but in these cases they did not appear to have undergone any degeneration.

The free granules increase in size, become oval, and their protoplasm becomes differentiated into a deeply staining central piece and a peripheral portion which stains more faintly. There is also developed a flagellum-like projection. Later the chromatin portion divides unequally.

From this point development appears to proceed in two different directions. In some of the parasites the body becomes elongated, the two masses of chromatin become separated from each other, and the true flagellum is developed. There is no undulating membrane.

In other parasites the body remains rounded in shape and the chromatin masses undergo division, each pair of large and small masses becoming provided with a flagellum attached to the smaller and projecting beyond the cytoplasm.

These forms have been found in man and in animals in preparations from glands, internal organs, and bone-marrow.

Attempts were made to infect animals with materials containing granules only. Blood containing large numbers of trypanosomes and granules was mixed with two volumes of 2 per cent. salt and 1 per cent. citrate solution and left at temperatures of from 34° to 38° C. for an hour. At the end of that time no trypanosomes could be found intact, they had all become swollen and rounded, and the still active granules had escaped.

It was found possible to infect gerbils in this way with *T. nanum*, trypanosomes appearing in the circulation in about 5 days.

In some instances the gerbils were killed before a trypanosome appeared in the circulation with the object of tracing the stages of development of granules into trypanosomes. In these animals granules and later stages were found in proximal glands and internal organs.

It was found to be impossible to stain the developmental stages of the granules by ordinary methods, but success was obtained with special methods devised by PLIMMER.

As an addendum to the paper there is a note by PLIMMER on a "New method of Blood Fixation."

There are two methods recommended, namely, fixation with the vapour of a solution of iodine in chloroform, and fixation with salt solution containing potassium iodide and iodine to saturation. It is said that there is much less distortion, and that there is finer fixation of details by these methods. The caryosome in the nucleus, the distinction between the micronucleus and blepharoplast, and the details of dividing forms are said to be far more clearly made out.

Vapour method.

The thinnest possible films are exposed to the vapour of iodine in chloroform for 10 to 15 seconds while still moist. When dry they are placed in chloroform or a mixture of ether and alcohol in equal parts for two hours. The preparations may then be stained in Giemsa, made by mixing one drop of Giemsa solution with two of distilled water, for 2 to 12 hours. They are then washed and treated with orange tannin solution for 15 seconds, again washed thoroughly, dried, and mounted in either cedar oil or liquid paraffin.

They may also be stained with carbol fuchsin for 2 to 12 hours, washed, treated with alcohol until the bulk of the stain is removed, differentiated with clove oil saturated with orange G, washed with xylol and mounted as before.

Fixation with iodine solution.

A saturated solution of iodine and potassium iodide in salt solution is made and 5 or 6 drops of this are added to 10 cc. of salt solution. This is mixed with the blood in equal parts and thickish films made. When the films have begun to dry they are placed in alcohol and ether for two hours and the succeeding steps are the same as those described in the vapour fixation method.

(495) Kleine (F. K.) & Eckard (B.). **Ueber die Bedeutung der Speicheldrüseninfektion bei der Schlafkrankheitsfliege** (*Glossina palpalis*). [The Significance of the Infection of the Salivary Glands in *Glossina palpalis*.] — *Zeitschr. f. Hygiene u. Infektionskrankh.* 1913. April 25. Vol. 74. No. 1. pp. 183-187.

In this paper are recorded the results of experiments in which a number of apes were inoculated with the contents of different portions of flies infected with *T. gambiense*.

Six apes were inoculated with the contents of the salivary glands and all these became infected. A second series of six were inoculated with the intestinal contents of the same six flies and in no case did trypanosomes appear in the blood. Three apes were inoculated with the contents of the proventriculus but these also failed to become infected. It would therefore appear that the infection of the salivary glands is an essential stage of the development of the trypanosome in the fly, and not in the nature of an accident.

(496) Roubaud (E.). **Evolution comparée des Trypanosomes pathogènes chez les Glossines.** [The Comparative Development of Trypanosomes in Glossinae.]—*Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. pp. 435-441. With 3 text-figures.

In this paper an attempt is made to devise a classification of the African trypanosomes based upon the manner in which the different species undergo development or maintain their existence in the flies.

According to the author there are two main classes, viz., those in which the trypanosomes are merely "cultivated," and those in which the trypanosomes undergo a process of "evolution" in

the fly. In the former the characteristic feature is the persistence of the trypanosome form, and in the latter there is a transformation from the trypanosome form into the crithidial type, which again changes into the typical trypanosome. Either of these conditions may be temporary or lasting.

In "temporary cultivation" the trypanosomes pass into the posterior portion of the midgut where the cultivation occurs, giving rise to no important modifications of morphology; there being as a rule an increase in size only. The process generally lasts only two or three days and occurs in the ingested blood only, disappearing when this disappears. The author states that this method of development is constant for the following viruses: *T. gambiense*, *T. dimorphon*, *T. congolense*, and *T. pecaudi*.

He has never observed it with the following viruses: *T. congolense*, *T. brucei* (Zululand strain at the Pasteur Institute), *T. cazalboui*, and *T. evansi*. [There appears to be an error in this statement as *T. congolense* occurs in both groups.]

This "intestinal cultivation" may in some cases become lasting, and may persist in the intestine even during a period of fasting, the parasite extending forwards to the anterior portion of the gut. There is never any infection of the rectum or of the Malpighian tubes, and cysts are never formed. When the whole of the mid- and fore-gut is invaded the author terms the invasion "infection totale."

While "temporary intestinal cultivation" is constant for the species mentioned, "lasting intestinal cultivation" occurs in a small proportion of flies only. This depends upon the species of Glossina, the locality, and the specific character of the virus. In the case of *T. dimorphon* in *G. palpalis* in Dahomey it was found in 1 per cent. of flies only.

This lasting infection of the intestinal tract must be considered as a "cultivation" because the morphological modifications which occur are very slight and closely resemble those seen in artificial cultures.

Finally, these forms are not inoculable to the vertebrate host.

"Evolution" in the fly is marked by the transformation of the parasites into crithidial bodies which occur solely in the salivary apparatus. This process may also be temporary or lasting.

The "lasting salivary evolution" may be divided into three types:—(1) That described as "direct fixation in the proboscis." In this type of evolution the parasites attach themselves directly to the wall of the proboscis in the form of short crithidia which develop into the salivary trypanosomes, these passing to the hypopharynx. (2) That described as "indirect fixation in the proboscis." In this type of evolution the infection of the proboscis is not derived direct from the blood ingested, but results from extension forwards from an "intestinal cultivation." This type of infection has been observed by the author in the case of *T. dimorphon* and *T. pecaudi*. These two trypanosomes are distinguishable by the forms taken in the hypopharynx. In the case of *T. dimorphon* they are short and devoid of a free flagellum, and in the case of *T. pecaudi* they are long and are provided with a flagellum. (3) Evolution by "indirect fixation in the salivary glands." This method of development

is peculiar to the two human trypanosomes. Infection of the proboscis in this instance also results from "*infection totale*," but the forms which invade the proboscis pass on to the salivary glands and there develop into typical trypanosomes.

From the biological point of view it is interesting to note that development by "direct fixation" in the proboscis only corresponds with a shortening of the cycle of passage in the fly and tends towards mechanical transmission. *T. cazalboui*, the evolution of which is the most simple, appears to be most easily transmitted mechanically.

"Lasting evolution" of *T. cazalboui* in the proboscis only has been observed by Bouffard in *G. palpalis* and *G. tachinoides*, and by Bouet and Roubaud in *G. morsitans* and *G. longipalpis* in addition, and by the members of the Belgian mission to Katanga in *G. morsitans*.

Bruce and his collaborators have observed it in the case of *T. vivax* in *G. palpalis*, and *T. caprae* in *G. morsitans*, and it has been observed by Fraser and Duke for *T. uniforme*. The author thinks that the absolute similarity of the method of development of these trypanosomes strongly suggests their "specific unity."

The author believes that four fundamental types of trypanosomes can be distinguished, basing the distinction on the evidence afforded by the method of multiplication in the fly.

These four groups are:—

The *cazalboui-vivax* type.
The *dimorphon-pecorum* type.
The *pecaudi* type.
The *gambiense-rhodesiense* type.

(497) Bruce (D.), Harvey (D.), Hamerton (A. E.), & Lady Bruce. **Infectivity of *Glossina morsitans* in Nyasaland.**—*Proc. Roy. Soc.* 1913. June 12. Series B. Vol. 86. No. B 589. pp. 422-426.

In the experiments recorded in this paper 10,081 flies in batches were fed each batch upon three healthy animals in succession on three consecutive days, and the feedings were repeated three times. The average number of flies in each batch was about 60, so that each animal might possibly be bitten by 180 flies.

In a table are given the results of these feeding experiments upon monkeys, dogs, and goats, and the species of trypanosomes found. The results showed that the following four species of trypanosomes are carried by *G. morsitans* in the district:—*T. brucei* vel *rhodesiense*, *T. pecorum*, *T. simiae*, and *T. caprae*.

T. brucei vel *rhodesiense* was found in 2 per 1,000. *T. pecorum* in 4·6 per 1,000, *T. simiae* in 3·4 per 1,000, and *T. caprae* in 3·5 per 1,000.

Infective flies occur at all seasons in about the same numbers.

The following are the conclusions drawn from the experiments:—

"1. The tsetse flies (*Glossina morsitans*) caught in the 'fly-country' near Kasu are infected with four species of disease-producing trypanosomes—*T. brucei* vel *rhodesiense*, *T. pecorum*, *T. simiae*, and *T. caprae*.

"2. The proportion of infective flies is 13·5 per 1,000.
"3. The proportion of flies infective with *T. brucei* vel *rhodesiense*, the cause of the Human Trypanosome Disease in Nyasaland, is 2 per 1,000.
"4. The flies are found infective all the year round.
"5. To prevent the infection of tsetse flies it is proposed that the experiment should be tried of destroying all the wild game in the "Proclaimed Area" of Nyasaland."

(498) Mitzmain (M. B.). **The Mechanical Transmission of Surra by *Tabanus striatus*, Fabricius.**—*Philippine Jl. Sci.* Sec. B. Trop. Med. 1913. June. Vol. 8. No. 3. pp. 223-229.

The author's success in transmitting surra by means of *Tabanus striatus* has already been referred to in this *Bulletin* (see abstract of MS. letter, Abstr. No. 275, Vol. 1, No. 3, May, 1913).

The majority of the flies used in the experiments recorded in this paper were laboratory bred, but in some instances the flies were obtained from larvae taken from their natural habitats, and in a few instances captured adult flies were used.

Experiments on the direct transmission of the trypanosome were alone carried out. The flies were first allowed to bite an infected guinea-pig or horse for not more than one minute, and were then transferred within five seconds to three minutes to a healthy animal to continue the feed.

A table shows that sixteen experiments were carried out. In these, one and two, and in one instance six flies were used. They were allowed to bite an infected animal as stated, and were then transferred to either a monkey, guinea-pig or horse. In three cases a positive result was obtained. One monkey became infected after it had been fed upon by three flies, and trypanosomes appeared on the eighth day. Its blood infected two guinea-pigs and a horse. In the second successful case a horse was infected by the bites of two flies. A mule, two guinea-pigs and two monkeys reacted to inoculation with this animal's blood. In the third successful case six flies were used to infect a horse. Two monkeys and two guinea-pigs were infected from this animal.

An attempt was made to get Tabanidae to bite animals confined in a large cage. During a period of about six weeks 2,087 female tabanids were liberated in the cage which contained two infected carabaos and one healthy one. The flies died within a few days when kept in the enclosure, and the result of the experiment was negative.

In order to exclude the possibility of hereditary transmission an experiment was carried out with 74 flies derived from eggs laid by a fly which had twice fed upon a heavily infected monkey. The result was entirely negative.

In an experiment with five guinea-pigs an attempt was made to transmit the infection by means other than biting. It was observed that flies placed on an abraded surface would take in surface moisture before biting, and that a fly could obtain sufficient material to fill the stomach in this way without biting.

Areas of skin on healthy and infected guinea-pigs were abraded with a razor and two or three flies were allowed to suck

blood from the surface for about a minute and were then transferred to the healthy guinea-pigs to finish their meal. In no instance was infection obtained.

When flies which had had a meal on an infected animal were used for the preparation of suspensions which were inoculated into guinea-pigs positive results were obtained when the interval elapsing between the infecting feed and the preparation of the emulsion did not exceed 10 hours.

The author's conclusions are as follows:—

"1. *Tabanus striatus* Fabricius for the first time recorded has been found to play a rôle in the transmission of surra. Bred horseflies have been employed for the first time in such experiments. Errors resulting from naturally infected wild flies have thus been eliminated.

"2. Three experiments were successful in the direct or mechanical transmission by 'interrupted' feeding when only a short interval was allowed between the bites on infected and healthy animals. In 16 experiments the minimum number of flies with which the infection could be transmitted was 2.

"3. Trypanosomes of surra were not found to be transmitted hereditarily by *Tabanus striatus* Fabricius.

"4. The contaminated labellum of the fly does not appear to be a factor in the conveyance of the infection.

"5. The maximum length of time that *Trypanosoma evansi* has been demonstrated microscopically in the gut of this species of fly after feeding on infected blood is thirty hours; the organisms were found in the fly's dejecta two and a half hours after biting the infected animal; and suspensions of flies, when injected subcutaneously, were found infective for animals for a period of ten hours after the flies had fed on infected blood."

(499) Wenyon (C. M.). **Experiments on the Transmission of *Trypanosoma lewisi* by means of Fleas.**—*Jl. London School Trop. Med.* 1913. April. Vol. 2. No. 2. pp. 119-123.

In a previous paper (see this *Bulletin*, Vol. 1, No. 3, p. 171) the author recorded the results of his experiments in which it was found that *T. lewisi* is capable of developing both in the human flea (*Pulex irritans*) and in the dog flea (*Ctenocephalus canis*). In the present paper an account is given of further experiments with the human flea, in which it was found that the rat is apparently not a suitable host for the human flea as it does not willingly feed, and soon disappears. It therefore seems improbable that *Pulex irritans* plays any part in the transmission of *T. lewisi* in nature, although it has been shown that its faeces are infective when it has been fed upon an infected rat.

In a further experiment it was proved that *Xenopsylla cheopis*, the common rat flea in India, is a true host of *T. lewisi*; a strain of the trypanosome being carried through three generations in rats by means of three fleas of this species. The periods elapsing before infection took place varied from 9 to 25 days, indicating that the infection is due to some chance such as the licking up by the rat of moist flea faeces. In cases in which the infective faeces were taken direct from the flea and introduced into the mouth of a rat the period of incubation was six to seven days.

The author disagrees with the view expressed by MINCHIN and THOMSON that infection takes place through the agency of small trypanosomes which have wandered from the rectum to the mid-gut and are regurgitated into the rat. His reasons are as follows:—He has not obtained positive results in any experiments in which the possibility of faecal infection has been excluded. The presence of a few small trypanosomes in the mid-gut is to be explained by the very vigorous peristaltic action of the intestine. Another point is that the final development of the infective forms takes place in the rectum rather than in the anterior portion of the gut, thus suggesting that it is the material from the hind-gut which is the source of infection.

(500) HECKENROTH (F.) & BLANCHARD (M.). **Transmission du *Trypanosoma gambiense* par des Moustiques (*Mansonia uniformis*).** [The Transmission of *T. gambiense* by Mosquitos (*Mansonia uniformis*).]—*Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. pp. 442-443.

It was recorded in 1908 by MARTIN, LEBOEUF, and ROUBAUD that they had been able to transmit *T. brucei* from one cat to another by means of Mansonia, and by FÜLLEBORN and MAYER in the previous year that trypanosomes (species not stated) could be transmitted from one animal to another by Stegomyia by interrupting a feed upon an infected animal and placing the mosquitos in contact with a healthy animal to finish their feed.

The two experiments recorded in the present brief paper were carried out with a strain of *T. gambiense* which had become adapted to multiplication in small rodents.

In the first experiment a healthy and an infected guinea-pig were placed in a cage divided into two parts by a partition reaching to two-thirds of the height. Sixty-four wild Mansonia were placed in the cage and the infected guinea-pig was removed at the end of forty-eight hours. Three Mansonia were found to be alive at the end of the experiment and these were dissected without any flagellates being found. The healthy guinea-pig was found to be infected on the 22nd day.

In the second experiment an infected guinea-pig was placed in the cage with 26 Mansonia. After 24 hours the guinea-pig was withdrawn and after a further interval of 24 hours a healthy guinea-pig was placed in the cage. The guinea-pig was left in the cage for 23 hours and then withdrawn. The animal was found to be infected on the 18th day. No trypanosomes were found in the 6 surviving mosquitos.

(501) LEESE (A. S.). **Some more Successful Experiments on the Treatment of Surra in the Camel with recommendations for Systematic Treatment.**—*Memoirs of the Department of Agriculture in India. Veterinary Series.* 1913. April. Vol. 1. No. 3. pp. 149-176.

This paper deals with further trials made with certain methods of treatment the details of which have already been published (see this *Bulletin*, 1912, Oct, Vol. 1, No. 1, Abstract 9, pp. 19-21), and with modifications of these treatments. Detailed

descriptions are given of the modifications employed and the results obtained are given and the paper closes with a revised set of rules for the treatment of surra in camels.

Leese after extensive experimentation advises the following method of treatment for camels, and gives the following as an "average" treatment (Treatment "668"):—

1st day, Soamin subcutaneously ...	5 g.
2nd day, Tartar Emetic intravenously	0·5 g.
3rd day, Arsenious Acid	0·6 g.

After an interval of two days this routine is repeated, increasing the dose of soamin to 6 grammes.

After further 4 days' interval it is again repeated with 6·5 g. soamin.

After a third interval of 8 days repeat with 6·5 to 7·5 g. soamin, the other days in constant quantities throughout. This method is recommended for camels that are in fairly good condition, and in the experiments it yielded 62 per cent. of cures, 22 per cent. of accidents and 16 per cent. of relapses.

Special emphasis is laid upon the fact that the dosage must be carefully graduated to size and weight of the animal. The quantities given are suitable for a camel weighing from 1,050 to 1,300 lbs. Weak and emaciated camels in which the disease has progressed too far to allow them to stand the above treatment should be subjected to the following, which is practically a matter of "kill or cure" (Treatment "178"). It has yielded cures, accidents, and relapses in about equal proportions. As originally described the method was as follows:—

1st day, 55 grains of sodium arsenate per os.
2nd day, 5 grammes of atoxyl subcutaneously.
3rd day, 1·5 g. antimony tartrate intravenously.
Repeated after 3 days' interval.

The conclusions arrived at are as follows:—

1. The best methods of treatment are:—
   (*a*) "668" treatment which gave 62 per cent. of cures, 22 per cent of accidents, and 16 per cent. of relapses.
   [The "668" method is a modification of the "436" method with the sodium arsenate per os replaced by arsenic intravenously.]
   (*b*) "264" treatment which has given over 50 per cent. of cures when applied to strong camels. It is unfit for weak ones, but does not appear to be dangerous to the strong.
   (*c*) "178" treatment which is very dangerous, but is the only hope for the camels which are too weak to stand a longer and better treatment. It cured 35 per cent. and killed 30 per cent.; the remainder relapsed.

2. Soamin in the place of Atoxyl and in exactly the same doses gave identical results, and as it is much cheaper it seems the best of the two drugs to use.

3. Arsenic given intravenously in solution in the place of sodium arsenate given by the mouth, acts as well or better in the longer treatments as regards curative action, while it is less violent in its action on the camel.

4. If a first treatment fails, a second may be applied provided the camel is in a condition to stand it, in which case the chances of cure do not seem to be reduced; from the above account it will be seen that a number of camels have been cured at the second attempt.

5. I have confidence now in saying that a camel is cured on the evidence of 6 months' daily blood-examination since the last dose of the treatment

whenever it is obvious either from blood-examination for a time prior to treatment or by the history of the camel, that the disease was in its acute or sub-acute stage before treatment began. The longest-delayed relapses have been 88 and 89 days, and I have had about 30 camels which have been kept for varying periods under daily blood-examination after that length of time, between 6 and 17 months since treatment and none have ever relapsed. All the first 9 camels cured were, moreover, tested by inoculation of their blood into guinea-pigs.

(502) Mouchet (R.) & Dubois (A.). **Note sur le Traitement des Trypanosomiases Animales.**—*Bull. Soc. Path. Exot.* 1913. July. Vol. 6. No. 7. pp. 533-539.

The following is a summary of the authors' conclusions:—

Trypanosoma congolense is very resistant to drugs. The authors have not been able to test the tryparosan which gave good results with Rodhain, Pons, Bequaert, and Vandenbranden. Trypasafrol is useless for the treatment of cattle and no conclusions have been arrived at in the case of goats treated with large doses.

Orpiment appears to have some effect, but it is dangerous.

Trypanosoma cazalboui is resistant to arsenic, but is susceptible to antimony. Trypasafrol has been used in very small doses but without success.

Emetic may produce apparent recoveries lasting for more than two months. It is advised that arsenic be administered at the same time in order to facilitate flattening and maintain strength. Five milligrammes per kilogramme may be injected intravenously with safety, and 7·5 mg. subcutaneously.

Yvon's emetic may be used in slightly larger doses, but it cannot be said that it has any advantages over ordinary emetic.

(503) Andrews (W. H.). **Some Experiments on the Drug Treatment of Trypanosomiasis.**—*Second Report of the Director of Veterinary Research. Union of South Africa. October,* 1912. pp. 362-383. (1913. Cape Town: Cape Times, Ltd., Government Printers.)

The experiments detailed in this paper were carried out with a number of strains of trypanosomes of the *congolense* (or *pecorum*) type. The various strains used were found to possess about an equal pathogenic power. In the earlier experiments horses and mules were largely used, but subsequently sheep were for the most part employed.

In horses the parasite generally appeared in the blood about the 21st day. Only two experiments were made with cattle, and the trypanosome appeared to be rather more pathogenic for them than for horses. In these the trypanosomes appeared in the blood on the 11th day and the animals died on the 43rd and 95th days. In sheep the average period elapsing before the appearance of trypanosomes in the blood was about six days. The duration of the disease varied greatly. About 50 per cent. of the sheep died within a month, while about 10 per cent. survived for a year. In dogs the trypanosomes made their appearance in the blood in from 9 to 15 days, and the animals died in from 15 to 36 days after inoculation.

It was recognised that the desired results could not be obtained from a single trypanocidal agent and a combination of two or more drugs was therefore used. There were made, however, a number of observations on the effects obtained with certain agents used alone.

Arsenophenylglycin.—Nine infected horses and mules were put under treatment, and in every case there was a relapse as indicated by subinoculations. The dose varied from 0·57 to 0·06 g. per kilogramme body weight. In view of the fact that the maximal therapeutic dose of the drug as fixed by EHRLICH is 0·05 g. it is evident that the dose could not be increased with safety.

The two cattle were given 0·059 and 0·074 g. per kilogramme body weight, but in neither case was the treatment effective.

Fourteen sheep were treated. In eleven of these which had received doses of 0·057 to 0·075 g. per kilogramme there was a relapse, generally about the third week. One sheep was given 0·06 g. per kilogramme, and there was no return of trypanosomes up to the 15th day, when further treatment was instituted.

Two sheep which were given 0·09 and 0·0617 g. per kilogramme were apparently cured. The results did not appear to be at all affected by the interval elapsing between the appearance of trypanosomes in the blood and the administration of the drug.

Novoflavin.—Six equines received a dose of 0·01 g. per kilogramme, and one mule was given 0·0098 g. per kilogramme. In three instances the animals treated were suffering from relapses after treatment with arsenophenylglycin, and in these cases there was no return of trypanosomes to the circulation, but the animals were killed about two months after the administration of novoflavin on account of debility.

One of the animals which had not been previously treated was found to be infected by subinoculation on the 169th day, and the remaining two were killed on the 11th and 25th days after treatment owing to debility. No relapse had been observed.

Eleven sheep were given doses varying from 0·009 to 0·013 gramme per kilogramme. In three cases the treatment proved fatal; two animals died shortly after from pneumonia, and in the remaining animals which had been unsuccessfully treated with arsenophenylglycin relapses occurred. It would appear that 0·01 g. per kilogramme is about the maximal dose for both horses and sheep as some fatal results followed doses of this magnitude in both species.

Salvarsan or "606."—Fifteen infected sheep were treated. In the first three cases the animals received salvarsan after unsuccessful treatment with arsenophenylglycin and novoflavin, and the drug was injected into the jugular vein in a 1 per cent. solution in normal saline.

In the remaining cases salvarsan was injected at an early stage of infection, these results being free from any sources of error connected with treatment with other agents. The strain used had been recovered from a sheep dying after unsuccessful treatment with arsenophenylglycin after it had been passed through five untreated sheep. The drug was given in a 1 in 500 neutral solution.

By experimentation with ten sheep the dose was fixed at 0·04 g. per kilogramme.

In no instance was there a complete disappearance of trypanosomes from the blood.

Combinations of trypanocidal agents.

1. Arsenophenylglycin and Novoflavin.

Of four equines subjected to this treatment, three received the novoflavin after an interval of 52 days, when a relapse following treatment with arsenophenylglycin had already been demonstrated. In the other case an interval of nine days only separated the administrations of the drugs. In no case were trypanosomes again seen in the blood and inoculations were negative. The animals which had been in poor condition at the commencement of the experiment were killed after two months on account of debility.

Fourteen sheep were treated. Two died within a day from intoxication and two succumbed to accidental complications. In two instances in which the injections were given on successive days, no relapses were observed and the animals died from accidental causes nine and fourteen months after the completion of the experiment. The remaining sheep showed relapses.

Five of these sheep were given a second dose of novoflavin. Two died shortly after, two had relapses, and one survived with no relapse.

The two drugs were administered simultaneously to a horse which had resisted treatment with arsenophenylglycin, and to two sheep which had not been treated. The horse died of debility after 52 days without a return of trypanosomes being recorded, and the sheep died in 4 and 12 days without relapse.

Three sheep were killed by the simultaneous administration of 0·07 g. of arsenophenylglycin, 0·025 g. trypanblue, and 0·001 g. sodium arsenite per kilogramme body weight.

The following treatment was administered to five sheep:

0·04 g. arsenophenylglycin, 0·01 g. trypanblue, and 0·008 g. tartar emetic. These were given intravenously with intervals of two days, and were followed at an interval of 11 days by 0·05 g. arsenophenylglycin and 0·008 g. tartar emetic, these being given half subcutaneously and half intravenously.

In two sheep which received both treatments a cure appears to have been effected, and in the other three the first course of treatment appears to have been sufficient to effect a cure, no relapses having been noted up to 130 days.

It was found that larger doses could not be administered with safety.

A single dose of arsenophenylglycin followed by successive doses of emetic proved fatal in four instances.

Relapses followed in every case when the treatment consisted of alternate injections of 0·05 g. arsenophenylglycin and 0·01 g. of tartar emetic.

The simultaneous injection of these drugs was unsuccessful in every case.

A combined treatment consisting of quinine and atoxyl was also unsuccessful.

(504) Lamballe (F. W.). **Trypanosomiasis and Surra. A preliminary Note upon the effect of Pancreatic Enzymes upon the Trypanosome of Surra. With an Explanatory Note by J. Beard, D.Sc.**—pp. 4. 1913. June 9. Edinburgh: Otto Schulze & Co.

In this brief note the author states that he administered to three relapse cases of surra in mules 3,750 units of trypsin and 1,000 units of amylopsin on two occasions at an interval of one day. At the time of treatment trypanosomes were numerous in the blood. On the day after the second administration only degenerated forms could be found in the blood, and on the following day no trypanosomes were to be found. The records are not carried any further.

(505) Offermann. **Zur Frage der Immunität bei Trypanosomenkrankheiten.** [Immunity against Trypanosomiasis.]—*Zeitschr. f. Veterinarkunde.* 1913. July. Vol. 25. No. 7. pp. 299-301.

A mare which was inoculated on four occasions with mouse or rat blood containing the trypanosome of dourine failed to show any symptoms of infection save that periodic rises of temperature were recorded. That the animal was actually infected was proved by repeated inoculations into mice. It was found that the blood was infective during the periods when the temperature was elevated, the inoculations failing during the afebrile periods. Agglutination and complement fixation tests both gave positive results.

(506) Darling (S. T.). **The Immunisation of Large Animals to a Pathogenic Trypanosome** [*Trypanosoma hippicum* **(Darling)**] **by means of an Avirulent Strain.**—*Jl. Experimental Med.* 1913. May. Vol. 17. No. 5. pp. 582-586.

A strain of this trypanosome that had survived in a guinea-pig for the exceptionally long period of 336 days was found on subinoculation on the 279th and 336th days to be feebly pathogenic when compared with other strains and with the same strain at an earlier period of infection. A dog inoculated on the day of death (336th) became infected but recovered. The usual duration of the infection in the guinea-pig is from one to four months. This strain was found to be of decreased virulence when used for the inoculation of a dog, a guinea-pig, and two mules.

In the case of one mule the period of incubation was lengthened to 11 days and the animal eventually recovered. This and other animals inoculated with a virulent strain were treated with arsenic, but the mule inoculated with the avirulent strain was the only one which survived. The animal passed through a typical attack and then appeared to recover. Its blood, however, remained infective for months, and it was only after rather more than a year after infection that it failed to infect a rat and a guinea-pig by inoculation, the dose used for the inoculation of the rat being 10 cc.

The history of the second mule infected (by means of *Musca domestica*) with the avirulent strain was very similar, but this animal was twice inoculated with a virulent strain without any infection being caused.

(507) Bonger (C.). **Ueber die Morphologie und das Verhalten der von P. Behn in deutschen Rindern nachgewiesenen Trypanosomen bei künstlicher Infektion.** [The Morphology of the Trypanosomes described by Behn as occurring in German Cattle in Animals infected experimentally.]—*Zeitschr. f. Hygiene und Infektionskrankh.* 1913. July 17. Vol. 75. No. 1. pp. 101-117. With 1 coloured plate.

The author has carried this trypanosome through four generations in calves. The course of the infection in each of the animals is given.

Three forms of the parasite are described:

a. The large slender type.—These measure on an average 55 microns in length by 2·5 in width. Their cytoplasm stains deeply, and the nucleus which is placed posterior to the centre of the body is generally round and compact. The blepharoplast as a rule lies nearer the nucleus than the posterior end, and is frequently kidney shaped.

b. The large broad type.—These measure about the same as the preceding in length, but are twice the width. They stain more faintly and their cytoplasm has a vacuolated appearance. The greatest breadth lies between the blepharoplast and the nucleus. The protoplasm frequently contains numbers of granules which stain of a deep violet tint. The nucleus is often placed transversely to the length of the parasite. The blepharoplast is about midway between the nucleus and the posterior end.

c. The small slender type.—These measure on an average 39 microns in length by 2 in width. The nucleus lies in the long axis of the body and the blepharoplast lies nearer to the posterior end of the body than to the nucleus. The blepharoplast is large and its shape often suggests that a piece has been cut out of it. The undulating membrane is rather poorly developed and the flagellum is fairly long.

The largest number of parasites were found in the liver, and the long slender forms outnumbered the other forms by two to one. As many as 50 parasites could be found in a single smear (whether "thick" or "thin" is not stated) made from the liver.

A few parasites were found which were rounded at the posterior end and there were a few round parasites. These measured on an average 9 microns in diameter.

The author failed to infect any animal other than the ox. The period of incubation was about 7 days. In one instance an inoculation proved successful when parasites had not been seen in the blood for 6 weeks.

Apart from a rise of temperature to about 40° C. which occurred in some cases before trypanosomes appeared in the blood there was no disturbance of health.

Parasites were discoverable in the blood for about 10 days.

(508) Ponselle (A.). **Technique pour le Coloration de Trypanosomes et Trypanoplasmes de Culture.**—*Compt. Rend. Soc. Biol.* 1913. May 23. Vol. 74. No. 18. pp. 1072-1073.

1. The dried smears should be covered with the following mixture:—

Absolute alcohol 50 cc.

Tincture of Iodine (French Pharmacopoeia) 10 drops.

Allow this to act for 5 minutes, wash with absolute alcohol and allow the specimens to dry.

2. Cover the specimen with serum. Horse serum heated to 56° C. does very well. Leave for 5 minutes. Wash in distilled water.

3. Stain with Giemsa made up in the usual way for 15 to 30 minutes. Wash and dry.

The method is of especial value for the staining of cultures of trypanosomes and trypanoplasms, but it does not give better results than those obtained in the usual manner with blood containing parasites.

(509) Kerandel (J.). **Trypanosomes et Leucocytozoon observés chez des Oiseaux du Congo.** [Trypanosomes and Leucytozooa found in Birds in the Congo.] — *Ann. Inst. Pasteur.* 1913. June. Vol. 27. No. 6. pp. 421-439. With 2 coloured plates.

The present article appears to be an elaboration of one which appeared in the *Bulletin de la Société de Pathologie Exotique* in 1909.

The descriptions given are based upon the examination of preparations made as soon after the death of the hosts as possible, fixed in absolute alcohol and stained with Giemsa. In most cases opportunity did not offer for the examination of moist preparations.

Trypanosome of the Guinea-fowl (Numida meleagris).

This parasite has a long slender fusiform body which is drawn out at both ends, particularly at the posterior extremity. The cytoplasm stains of a deep bluish-violet colour at the centre of the body, but more faintly at the extremities. It is granular and shows some ill-defined granules.

The nucleus is rounded, centrally placed, and somewhat ill-defined.

The centrosome is oval and large, and is placed at some distance from the posterior extremity. The undulating membrane is well-developed and is thrown into voluminous folds. There is no free flagellum. The parasite measures about 70 microns in length and 4 microns at its greatest breadth.

Trypanosome of the Francolin (Francolinus bicalcaratus).

The author believes this to be a new species and suggests the name *T. francolini*. The special characters of the parasite are its great length as compared with its slenderness, and the great distance between the nucleus and the centrosome (nearly 20 microns).

The organism is drawn out at both ends. The cytoplasm stains deeply and is granular, and contains a number of vacuoles, one of which is elongated and starts at the centrosome and extends forwards. The ectoplasm shows discrete longitudinal markings. The nucleus is rounded and placed about the middle of the body. The centrosome is large and stains deeply. The undulating membrane is well-developed, but there is no free flagellum. The parasite measures from 55 to 65 microns in length and from 3 to 3·6 microns in width.

Trypanosome of Pycnonotus tricolor.

In the fresh state this parasite does not execute very rapid movements. The centrosome is very refractile and can be seen at that point in the body where it begins to taper. The nucleus is less clearly seen. The undulating membrane is very mobile and is thrown into a number of folds. Sometimes the movement involves translation but sometimes there is none. During movement the posterior portion of the body appears to be passive. When there is no movement of translation the parasite assumes a curved outline, and while revolving upon itself describes an almost perfect circle. In stained preparations the organism is observed to taper markedly towards its extremities, especially in the anterior direction.

The nucleus is rounded and placed towards the middle point of the body, but is sometimes a little posterior to that.

The centrosome is large and rounded, and lies in a large oval vacuole.

The parasite measures about 50 microns in length by 5·5 in width.

The trypanosome is said to differ from that described by Mathis and Leger in a bird belonging to the same family, in that the latter showed a rod-shaped centrosome, the membrane was thrown into a few folds, and the posterior extremity tapered to a less degree.

Trypansome of the Vidua (Vidua serena).

This parasite somewhat resembles *T. bouffardi*, but the latter has a thicker body and a rod-like centrosome. The organism differs from *T. paddae* in that its centrosome is small and it shows no longitudinal markings.

Trypanosome of the Screech-owl (Strix flammea trimaculata).

Only one specimen of this parasite was found. It is possibly identical with *T. avium*. The length of the specimen found was 55 microns and the breadth 5 microns. There was a very slender free flagellum measuring 9 microns.

Trypanosome of the Roller (Eurystomus gularis).

This is a somewhat stout trypanosome and measures from 50 to 57 microns in length by 5 to 9 microns in width. The extremities do not taper much. The body stains deeply except posterior to the centrosome where it takes a very pale tint and it shows longitudinal striations. The centrosome is large. There appears to be no free flagellum in the majority of the organisms, although in three specimens a short one could be made out.

Trypanosome of the Fern-owl (Caprimulgus fossei).

Two types of trypanosome were found in this bird.

The larger trypanosome in the fresh state is very active and its movements always involve translation.

In stained preparations it is seen that the posterior extremity of body of the parasite terminates somewhat bluntly and suggests the head of a porpoise in shape, while anteriorly the body tapers off gradually from the nucleus. The whole of the body takes a deep blue colour including the portion posterior to the centrosome. The nucleus is clearly outlined and is placed rather posterior to the centre of the body. The centrosome is rod-shaped. The parasite measures from 43 to 47 microns in length by 5 to 6 in width.

The smaller trypanosome is not so active, and translatory movements are not observed. In the fresh state it can be seen that the undulating membrane makes three turns round the body in a spiral manner.

In stained preparations the body is faintly coloured. The extremities are seen to be rather bluntly conical. The centrosome is large and rounded, and situated quite close to the posterior extremity. The undulating membrane itself is scarcely visible, but the flagellum enables its course to be followed. No free flagellum can be seen.

The parasite appears to be a little more than 20 microns in length by about 5 microns in width.

In the blood of a bird about the size of a lark, the species of which was not determined, a trypanosome closely resembling the small parasite found in the fern-owl was discovered.

Leucocytozooa.

In the majority of cases these haematozoa were included in cells which in some cases were rounded and in others fusiform. The author agrees with MATHIS and LEGER that the same parasite may be found in these two types of cell. He considers that the fusiform cells represent erythroblasts (cells related to erythrocytes but devoid of haemoglobin) and the rounded cells mononuclear leucocytes. The author's classification is based upon the view that each species of parasite infects only one family or allied genera.

Leucocytozoon of the Guinea-fowl (Numida meleagris).

This organism was found in the blood of the bird that was the host of the trypanosome already described. The parasite appeared to be practically identical with that described as occurring in the blood of a closely allied species in the Soudan, and it closely resembled that observed by MATHIS and LEGER in domestic poultry in Tonkin.

In the fresh state the body of the parasite appears granular and the nucleus is not visible. In stained preparations the sexual forms are easily distinguished.

Macrogametes measure from 14 to 18 microns in length by 5 to 8 in width, and possess granular cytoplasm which stains of an intense blue. The nucleus is rounded, oval, or crescentic, and composed of compact chromatin granules.

The microgametes are slightly more slender than the macrogametes. The cytoplasm stains of a faint pink tint. The nucleus is large and ill-defined.

The host cell in both instances becomes drawn out at the poles, and in most cases contains numbers of red granules.

Leucocytozoon of the Francolin (Francolinus bicalcaratus).

The parasite found in this species was of the same type as that found in the Egyptian guinea-fowl, but on account of certain morphological characters the author believes it to be a distinct species.

The cytoplasm of the macrogametes is granular, vacuolated, and stains blue. The nucleus is small, oval, and contains only a small amount of chromatin.

The cytoplasm of the microgametes is more finely granular and stains pink or pale blue. The nucleus is large and oval, and appears as a pink vacuole placed transversely across the body. The microgametes are as a rule a little smaller than the macrogametes.

The host cells are sometimes leucocytes and sometimes erythroblasts.

Leucocytozoon of the Screech-owl (Strix flammea trimaculata).

The leucocytozoon found in this species closely resembles that found in the little owl and possibly the two are identical.

Leucocytozoon of the Fern-owl.

In this species parasites were found both in erythroblasts and in leucocytes. The parasites contained in the former were more elongated than those present in the latter.

The cytoplasm of the macrogamete is granular, vacuolated, and stains of an intense blue colour. The nucleus is large, poor in chromatin and stains faintly.

The microgametes possess only a small amount of cytoplasm which stains of a greyish-blue colour. The nucleus is very large and owing to the presence of small granules of chromatin stains of a pink colour.

The parasite differs from that described by Danilewsky in that it is larger, the nucleus stains more faintly, and there is more marked flattening of the nucleus of the host cell.

Leucocytozoon of the Roller (Eurystomus gularis).

The organisms were very scanty in the blood of this bird, a dozen only being found in two preparations which were thoroughly examined.

Like the preceding, this parasite is encountered in two types of host-cell.

The macrogametes have a granular protoplasm in which are scattered irregular vacuoles. The nucleus is oval and contains a large amount of chromatin.

The microgametes are smaller and stain of a faint pink colour. The nucleus is represented by a diffuse mass of finely granular chromatin. In the young parasites it forms the bulk of the organism.

SPIROCHAETOSIS.

(510) Marchoux (E.) & Couvy (L.). **Argas et Spirochètes. Premier Mémoire. Les Granules de Leishman.**—*Ann. Inst. Pasteur.* 1913. June 25. Vol. 27. No. 6. pp. 450-480. With 15 text-figures.

The granules may be found in the tick in all stages from the egg to the adult. In the egg they are found scattered through the whole of the mass, but in the larvae they are localised in the Malpighian tubes, and in the adult in the ovules and genital passages also. The granules are always intracellular in position, and are collected together into little masses. In sections it can be seen that the entire protoplasm of the affected cells is packed with masses of small spherical bodies.

In the epithelial cells of the genital passages the granules are as a rule less numerous. In young ovules, before the formation of any vitelline, the granules can be seen arranged in more or less regular rows in the protoplasm. In this situation distinctly rod-like granules can be found. A similar disposition of the granules is somewhat rarely seen in the Malpighian canals.

It is stated that English authors have been mistaken in supposing that all spirochaetes disappear from ticks that are kept at a temperature of 15° C. to 28° C. for several weeks after an infective feed, this view being based upon the results of most careful microscopic examinations. The authors claim to have been able to find spirochaetes in the coelomic liquid of ticks that have been kept at 28° C. for 45 days. They claim that gentian violet is far more reliable for the demonstration of the organisms than Giemsa.

Starvation does not cause the disappearance of the spirochaetes. They have been able to find spirochaetes in the coelomic liquid of ten ticks which were starved and kept at a temperature of 15° C. for 11 months.

In a second series of experiments it was found that alternation of temperature between that of an ice chest and that of the laboratory failed to sterilise the coelomic liquid, and that spirochaetes were actually more numerous after five months than they were before.

Brief details are given of one of a series of experiments by which it was shown that the ingestion of antibody from a hyper-immunised fowl failed to kill the spirochaetes in ticks, organisms being found nine months later, although the ticks had had no infective feed during the interval. The serum of the fowl used was very active *in vitro*. One of the ticks used in this experiment laid a batch of eggs, and spirochaetes were found in the larvae when they hatched two months later.

The authors state that they have failed to sterilise ticks by the direct injection of active immune serum. The injection caused a temporary disappearance of the parasites, but if the ticks were given a feed of normal fowl blood parasites reappeared in a few days in 60 per cent. of instances.

In starved ticks the spirochaetes are smaller than normal and so slender that they may easily escape observation, but within

twenty minutes of a starved tick engorging normal blood the parasites can be seen to have increased in size up to the normal. If ticks are deprived of their organs of sense in the manner devised by HINDLE and are then allowed to engorge themselves with salt solution through a membrane, no enlargement of the spirochaetes is observed.

Experiment has shown that these slender spirochaetes are virulent by inoculation.

The following is a brief account of the authors' views regarding the fate of spirochaetes ingested by ticks from an infected fowl.

Some of the ingested parasites pass through the walls of the caeca and appear in the coelomic cavity about twenty minutes after the infective feed, but the great majority of the organisms remain in the caeca.

In the preparation of specimens of material from the interior of the intestine it was found to be easy to obtain intestinal contents without coelomic fluid by puncturing the dorsal carapace with a needle, the distended caecum becoming herniated through the opening, and thus allowing some of its contents to be withdrawn with a fine pipette. By practising this method the following facts were ascertained:—

Eighteen hours after engorgement the spirochaetes are still motile and present the same appearance as in the blood, but in a minority of them the chromatin is broken up into from four to eight rod-like fragments.

After twenty-four hours there is marked agglutination of the parasites, and with the ultra-microscope the agglutinated organisms appear as a series of refractile points. During this period of immotility it can be seen that the parasites act as centres of attraction for a number of exceedingly small refractile bodies which are present in the liquid. These granules collect along the organisms and give them a swollen appearance. A current in the liquid is sufficient to detach some of these granules, and unless the whole process has been observed the impression is created that the granules are being projected from the body of the spirochaete. When motility is completely lost the parasite becomes ill-defined and breaks up. This occurs in about a couple of hours.

After forty-eight hours the degeneration of the parasites is obvious. In many of them the endoplasm has become herniated through the ectoplasm at one or more places, either at the sides or ends of the organism.

After three days there may still be a few motile parasites, but these execute only a slow undulating movement. Many have by this time penetrated red corpuscles where they move around the nucleus. Numerous degenerated parasites and organisms with fragmented chromatin can be seen, and the whole preparation swarms with fine debris resulting from the degeneration of red corpuscles and spirochaetes.

After four days the haemolysis of the ingested blood is nearly complete. Spirochaetes that are abnormally slender and others that are abnormally short and stout can be observed in a state of active motility, while the organisms of normal dimensions are absolutely motionless.

By the following day there are but few intact corpuscles left, but abnormal spirochaetes are numerous and very motile.

The spirochaetes gradually disappear and they are rarely observed on the tenth day.

The authors disagree with those who see in the fragmented spirochaetes the stage preceding granule formation, and they consider that the fragmentation of the chromatin indicates the first stage in the degeneration of the parasite. Such forms are never seen in the circulating blood save during the period immediately preceding the crisis, when a few may be seen in the midst of agglutinated masses of the organisms. In the tick they are never seen external to the caeca and their presence there is limited to the period of digestion.

On the other hand this degeneration is observed whenever the spirochaetes are placed under adverse conditions. It can be seen in organisms contained in blood that is taken aseptically and kept in tubes, within 24 hours. The process is hastened if the tubes are kept at 37° C., but the degeneration is delayed for some days in the ice chest. When spirochaetes are placed in contact with antibody the degeneration is greatly accelerated. Exactly similar changes are said to occur in other blood-sucking parasites when these are engorged with blood containing spirochaetes.

That the short and stout spirochaetes result from degeneration or rather digestion is shown by the discovery of similar organisms in bugs and leeches engorged with blood containing spirochaetes, the authors having shown by experiment that spirochaetes present in the coelomic cavity do not pass into the caeca. Similar changes are observed in spirochaetes in tubes containing media which will not allow of multiplication of the organisms.

The nature of Leishman's granules.

It is said that the changes in shape observed under different conditions of temperature are also to be observed in ticks kept at the temperature of the laboratory.

The authors have never seen any transformation of the granules into spirochaetes, and they have not been able to induce such transformation *in vitro*. Further, if the granules develop into spirochaetes which subsequently again become changed into granules these latter should show the same susceptibility to specific antibodies as the spirochaetes themselves. This was not found to be the case.

In the majority of cases failure has followed attempts to produce infection by inoculation with Malpighian tubes containing the granules, nor does immunity always follow inoculation with such material.

If the granules are in reality a stage of the spirochaete, inoculation with enormous quantities should produce infection. This however does not occur in the majority of instances, and it has been found that the salivary glands which are devoid of granules are actually superior to the Malpighian tubes in their content of immunising material.

Attempts were made to produce granules in bugs and leeches by feeding them on blood containing spirochaetes, but in no case could any be found. In view of the fact that the bug and the leech are

species widely different from the tick the authors examined other acarine parasites and found that these also contained granules of similar shapes, sizes, and staining reactions, and in the same situations. The question as to what is the real nature of the granules of Leishman remains unanswered.

(511) Launoy (L.) & Lévy-Bruhl (M.). **Les Variations Numériques des Globules Blancs chez les Poules infectées de *Spirochaeta gallinarum*.**—*Compt. Rend. Soc. Biol.* 1913. April 18. Vol. 74. No. 13. pp. 754-756.

The numerical variations in the number of leucocytes were always very small, and much smaller than those observed in certain types of leucaemia in the fowl, and in fowls infected with tuberculosis.

There was an increase of polynuclears during infection, and an increase in the mononuclears after the crisis. The increase in the polynuclears occurred in two phases. In the first phase there was an increase in the polynuclear cells containing the rod-like granules, and in the second phase the polynuclear cells containing the rounded granules [eosinophiles?] were observed. The morphological variations although constant are not specific since they occur in other diseases.

LEISHMANIASIS.

(512) Gray (A. C. H.). **Leishmaniose naturelle du Chien à Tunis.**—*Arch. Inst. Pasteur Tunis.* 1913. No. 1-2. pp. 102-106.

From the figures published by different authors it appears that the number of infected dogs in the countries bordering on the Mediterranean is very variable. The highest percentage of infected dogs is 81 at Bordanaro (Messina) and the lowest 1·1 per cent. at Catano.

The author undertook the examination of the dogs in Tunis. This had already been done by other investigators and the figures arrived at have been in close correspondence, namely 1·6 to 1·8 per cent.

In view of the fact that the brothers Sergent during July, August and September found 7·2 per cent. of dogs infected in Algiers, the possibility suggested itself that the percentage might be higher in Tunis during the later months of the year, the previous examinations having been carried out in the early part of the year. The author's examination was made during October and November, and out of 127 dogs only two were found to be infected, that is 1·6 per cent.—the figure arrived at by Yakimoff in 1911.

The materials used for examination are not stated.

(513) Patton (W. S.). **Is Kala Azar in Madras of Animal Origin? Preliminary Report.**—*Indian Jl. Med. Research.* 1913. July. Vol. 1. No. 1. pp. 185-195.

This paper contains the results of a number of animal inoculations with material taken from cases of the disease in the human subject and from experimentally infected animals, and the

results of the examination of a large number of bazaar dogs for the presence of leishmania.

In the first series of animal inoculations three monkeys, four dogs, two jackals, two guinea-pigs, two rabbits, two cats, four white rats, a goat, a calf, and a young pig were used. A fortnight later these animals were again inoculated with splenic emulsion from a case of the disease in the human subject. The material used was very rich in parasites.

In all the monkeys parasites were found in the organs and bone marrow. The animals had shewn wasting of the muscles with great weakness and there was marked diarrhoea.

Leishmania was found in all the dogs at the time of death and in three of them the infection was complicated with piroplasmosis. In those dogs in which piroplasms were found in the blood leishmania was also found, in many cases in leucocytes. The dogs lived several months after inoculation.

One of the jackals died with symptoms suggestive of kala azar, but a careful search failed to reveal the parasite, and a control jackal which had not been inoculated died showing the same symptoms. The other jackal that was inoculated not only contracted kala azar but also canine piroplasmosis. This is the first case that has come under the author's notice of a jackal which is ordinarily immune to canine piroplasmosis becoming infected.

Of the four rats, one became infected and died, and the other showed no parasites in its organs at the time of death.

The calf, pig and goat maintained perfect health.

In a further series of experiments five monkeys, ten white rats, and seven dogs were inoculated some with material from human cases and some with material from animals in the previous series.

One monkey which was inoculated subcutaneously with material from a monkey in the previous series became infected and died, but there was no evidence of a local lesion at the seat of inoculation. Parasites were plentiful in smears made from the organs. Another monkey died with symptoms suggestive of kala azar, but no parasites could be discovered at the post-mortem. The other three monkeys appear to have escaped infection.

Mention is made of five rats under these "additional experiments" and no evidence of infection was found in any of them, but it may be pointed out that according to their numbers two of those mentioned belong to the first series of experiments.

Two of the dogs inoculated respectively with fluid obtained by splenic puncture from a case of the disease in the human subject, and with bone marrow from the infected jackal, died but neither shewed leishmania on examination.

The two cats which were inoculated were killed six months later and both were found to be healthy.

Examination of spleen and bone marrow smears from bazaar dogs.

During the period January to November 1912, the author examined smears from the spleens of 1438 dogs destroyed in the lethal chambers and in no instance detected kala azar parasites.

It having been suggested that the parasites might be overlooked if the bone marrow were not examined, the author examined the bone marrow as well as the spleen pulp of 1,321 dogs, but failed to find a single parasite.

During the past seven years the author has examined about 300 cats, but has never seen leishmania in them.

The author feels justified in concluding "that the dog, and probably the cat, play no part in the transmission of kala azar in Madras."

(514) Donovan (C.). **Kala Azar: Its Distribution and the probable Modes of Infection.**—*Indian Jl. Med. Research.* 1913. July. Vol. 1. No. 1. pp. 177-184.

Geographical Distribution.—Outside India the presence of the disease has been recorded in China, the Yangtse Valley, and in the Soudan. "The disease as found along the littoral of the Mediterranean we may at present exclude and relegate to another form of Leishmaniasis, as this affects mainly, if not exclusively, children, and is apparently closely connected with the canine form of the disease."

In India the disease is found endemic in damp low-lying districts near the deltas of the Ganges and Brahmaputra. The disease has been said to occur in Assam, but the author suspects that the outbreaks were in reality of malarial origin, for the reason that the disease is said to have occurred as an epidemic and not endemically. The disease is endemic in the Madras Presidency.

Modes of infection.—There are two probable modes of infection:—(1) By means of insects, and (2) by ingestion, with infection though the mucous membrane of the intestinal tract.

1. By insects:—(*a*) Bed bugs.—Strong evidence of this has been adduced by Patton, but several points are wanting to enable this view to be accepted in its entirety.

(*b*) Conorrhinus—*Conorrhinus rubrofasciatus* has been suspected by the author. He had not been able to get any multiplication of the organism in this species, but he thinks that it should be suspect for the reasons that it is known to suck human blood and that another species of the same genus has been found to transmit a human trypanosome in Brazil.

(*c*) Mosquitoes—Very little experimentation has been done with these diptera, and it is pointed out that they harbour flagellates which may be readily confused by an inexperienced observer with leishmania.

(*d*) House fly—*Musca nebulo* has been singled out as a transmitter, not by biting, but by transferring infective material to foodstuffs or to abrasions.

(*e*) Lice and ticks—These have been tested by Patton with negative results.

(*f*) Dog-fleas—In Europe a fairly strong presumptive case has been made out as to the part the dog plays as an intermediary host, the dog flea being the actual transmitter.

"But the evidence adduced so far is not in all respects convincing. The occurrence of a natural flagellate of the flea has evidently not been taken into sufficient account."

The liver and spleen of a large number of dogs have been examined in India but no evidence of infection with leishmania has been obtained.

The author has been able to detect the parasite in the bone marrow of a dog inoculated into the liver with 3 cc. of blood taken from the spleen of a human being. In this instance examination of the liver and spleen failed to demonstrate the parasite.

2. By ingestion:—In a fairly large proportion of cases the disease in the early stages resembles typhoid, but the rise of temperature after a month or more of apyrexia identifies the nature of the infection. In all cases there are periods of diarrhoea and dysentery. In fatal cases evidence of ulceration of the large intestine is marked, and Leishmania is found in scrapings from these ulcers. This lends a certain amount of probability to the view that the parasite gains access to the system by way of the intestinal mucosa. It is true that Leishmania has not been found in the faeces of patients. Ankylostomes and trichomonads are frequent in such evacuations and the possibility is suggested that these might harbour the parasite. CHRISTOPHERS has examined ankylostomes but has not been able to find a trace of Leishmania in them.

(515) WENYON (C. M.). **A further Note on a Case of Dermal Leishmaniasis from South America, with the Results of Inoculation Experiments.**—*Jl. London School Trop. Med.* 1913. April. Vol. 2. No. 2. pp. 117-119.

In the first portion of this paper is given an account of the successful treatment of the disease with an ointment composed of equal parts of methylene blue, lanoline, and vaseline as recommended by CARDAMATIS and MELISSIDIS.

The second portion briefly summarises the results obtained by inoculating animals with cultures of the parasite. The cultures of the organism were much more luxuriant than those obtained from *L. tropica.* On two occasions intravenous inoculations were made into rabbits, and on one occasion a mouse was inoculated intraperitoneally, but in each case the result was negative. A human being inoculated by intracutaneous injection and by scarification failed to become infected.

A dog originally inoculated with material derived directly from the patient became infected and from it material was obtained for the successful inoculation of a second dog. From the second dog were inoculated a puppy—intravenously, two mice—intraperitoneally, and a cat on each ear. The puppy and the mice failed to become infected, but the cat developed two small pinhead nodules at the seats of inoculation after two months. Leishmania were discovered in the lesions both by culture and by microscopic examination.

(516) Kohl-Yakimoff (Nina), Yakimoff (W. L.), & Schokhor (N. J.). **Leishmaniose Canine à Taschkent.**—*Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. pp. 432-433.

The authors have examined 76 dogs at Taschkent (Turkistan) and have found 22 affected with leishmaniasis.

TOXOPLASMOSIS.

(517) Laveran (A.) & Marullaz (M.). **Infections du Lapin par le *Toxoplasma gondii*.** [Infection of the Rabbit with *Toxoplasma gondii*.]—*Bull. Soc. Path. Exot.* 1913. April. Vol. 6. No. 4. pp. 249-254.

After pointing out that Nicolle and Conor failed to infect rabbits with this organism, the authors pass on to describe their experiments in this connection.

The material used for the inoculations was the peritoneal exudate of a mouse infected with the parasite.

Eight rabbits were used. Of three inoculated into the peritoneum two shewed no infection, but the third died on the eighth day of a generalised infection. Parasites were very scanty, especially in the peritoneal exudate.

Five rabbits were inoculated intravenously and all became infected, death occurring in from 4 to 7 days.

The authors state that the failure of Nicolle and Conor to infect rabbits was due to the fact that they used intraperitoneal inoculations only. Young rabbits are more susceptible than adults.

In young rabbits white nodules appear on the surface and in the substance of the liver, giving the organ a characteristic appearance.

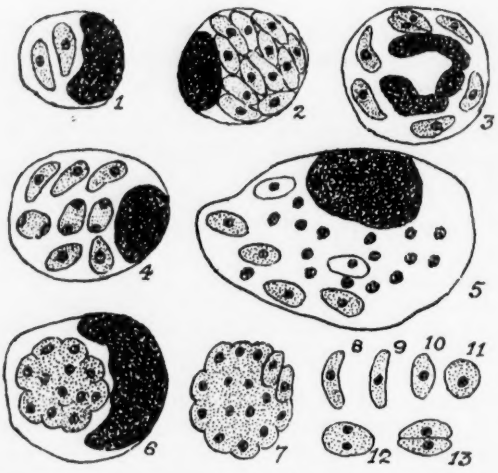
In rabbits inoculated intravenously the parasite may be present in fairly large numbers in the liver, and very frequently is found in the hepatic cells. Histologically the lesions are identical with those produced by *T. cuniculi*, and are due in all probability to the production by the parasite of a toxin which causes necrosis, and which is also, no doubt, the cause of death.

There is always enlargement of the spleen and the parasite may be present in large numbers. Microscopic examination reveals the presence of small centres of necrosis.

In the majority of rabbits dying of the infection there is congestion of the lungs, and parasites may be present in considerable numbers.

The organism is to be found in the bone marrow and in the brain, but it has been found in the blood of one rabbit only.

In one instance a rabbit inoculated intraperitoneally failed to shew any signs of infection, and when inoculated intravenously it again resisted infection. Possibly in this instance the first inoculation caused a latent infection which produced immunity.



Toxoplasma gondii, endocellular or free in the peritoneal exudate of infected mice. (From the paper by Laveran & Marullaz in the *Compt. Rend. Acad. Sci.* 1913. Vol. 156. No. 17. pp. 1298–1302.)

1 and 2. Mononuclears containing toxoplasms. 3. Polynuclear containing toxoplasms. 4. Endothelial cell containing toxoplasms, three of which are dividing. 5. Endothelial cell containing toxoplasms, some with clear outline and others of which the nuclei only are seen. 6. Endothelial cell with agglomerated toxoplasms. 7. Agglomeration of toxoplasms; the contours of two are seen. 8–11. Free toxoplasms. 12–13. Division stages. (Magnification about 1,600 diameters.)

(518) Laveran (A.). **Présentation d'un Chien infecté de Toxoplasmose.**—*Bull. Soc. Path. Exot.* 1913. May. Vol. 6. No. 5. p. 294.

At the meeting of the Society held on May 14th, 1913, Laveran shewed a dog that had been inoculated into the saphena vein with dilute peritoneal exudate obtained from a mouse infected with *Toxoplasma gondii*. After inoculation the dog rapidly lost flesh, and opacity of the cornea made its appearance in about three weeks. A fortnight after inoculation the parasite was found in the blood and there was marked increase in the number of polynuclear leucocytes. In one case a single leucocyte contained nine parasites.

The possibility is suggested that *T. cuniculi*, *T. gondii*, and *T. canis* are identical.

(519) Splendore (A.). **Des Formes Flagellées et des Gamètes dans le *Toxoplasma cuniculi*.—*Bull. Soc. Path. Exot.*** 1913. May. Vol. 6. No. 5. pp. 318-323. With 1 plate.

In a previous communication the author suggested the possibility that there might be a flagellate stage in this parasite, basing the suggestion upon a few observations from which the possibility of error was not excluded. In the present paper a description is given of the flagellate form, the occurrence of which the author claims to have established.

The flagellate referred to was found in a preparation from the liver of a pigeon experimentally infected with *T. cuniculi*.

The body of the parasite measured 5·5 microns in length and 2·2 in width. It was slightly curved and had one extremity rounded and the other somewhat pointed. The protoplasm was vacuolated to some extent and stained pale blue. The nucleus was rounded or slightly elongated in the transverse diameter of the body, and situated at a point one third of the length of the body from the more pointed end. It appeared to be composed of a chromatic zone without obvious structure. There was a large caryosome from which started a filament. This passed along the convex border of the parasite and gaining the pointed extremity was continued for a distance of 14 microns as a free flagellum. This flagellum appeared to be composed of a number of rods of chromatin enclosed in a thin protoplasmic envelope. The terminal portion of the flagellum was a little swollen. The exact significance of the flagellated form is not quite clear, as in the author's opinion he has observed the true gametes of the parasite. These bodies he has observed in smears made from the pectoral muscles of experimentally infected pigeons. On the surface of these muscles are to be observed little greyish streaks suggestive of sarcosporidia. Microscopic examination of these shewed that they were collections of toxoplasma. The dividing forms which have already been recognised could be found, and in addition to these there were other forms presenting some slight differences. The principal difference presented by these forms was the situation of the nucleus, which was placed close to one extremity of the parasites. In stained preparations these forms with the displaced nucleus were sometimes as numerous or even more numerous than the dividing forms. The bodies were fusiform, and stained of a deep blue tint, and sometimes shewed blue granules. The nucleus was formed of a compact or granular rounded mass of chromatin.

Some of the preparations in which these bodies were found were made direct with the muscle juice, but in other cases the material had been first diluted with salt solution and the preparations were allowed to dry in the air. In the latter cases some of the bodies were found to have undergone changes of shape, the alteration being from the fusiform to the round, and also an increase in size. In these parasites the nucleus was generally close to one side of the body and at the opposite side of the organism there were one or two little rod-shaped pieces of chromatin, which are believed by the author to result from reduction of the nucleus.

In some of the parasites there were two or four nuclei resulting from division of the primary nucleus, and in some of these two of the nuclear fragments were disintegrating, while from the others were developed two chromatin filaments which in many cases passed right across the body of the parasite and projected free from the opposite side for a distance of three or four microns.

In preparations made direct from the tissues and fixed at once the fusiform parasites shewed no modifications whatever, and the

author therefore concludes that the production of the chromatin filaments must have taken place outside the body. The author suggests that the production of these forms in the superficial tissues indicates infection of an intermediate bearer, but states that no definite conclusion can be arrived at at the moment. It is suggested that Stomoxys is the intermediate host.

(520) Marullaz (M.). **Au Sujet d'un Toxoplasme des Oiseaux.** [Toxoplasmosis of Birds.]—*Bull. Soc. Path. Exot.* 1913. May. Vol. 6. No. 5. pp. 323-326. With 9 text-figures.

After quoting at some length from a paper by Laveran which appeared in the *Comptes Rendus de la Société de Biologie* in 1900, the author gives a brief description of his examinations of a number of different species of birds.

Marullaz has found that the best results are obtained with preparations fixed in absolute alcohol for 4 to 6 hours and stained in Giemsa (1 drop to the cubic centimetre) for six to ten hours.

The majority of the investigations were carried out on *Padda oryzivora*.

The organisms, which often measure 5 or 6 microns in length by 2·5 to 3 in width, may be found in the liver, lung, and cardiac blood, but far more numerously in the spleen and bone marrow. In the blood the parasites are always within leucocytes. Multiplication takes place by longitudinal division.

The parasite has also been found in *Estrilda phoenicotis*, *Lagonosticta senegala*, *Quele aerythrops*, *Pyromelona franciscana*, and *Fringilla coelebs*.

Attempts to transmit the infection from padda to padda did not yield very satisfactory results, as it was impossible to determine whether a bird, which on post-mortem was found to be infected, had contracted the infection naturally or as a result of the inoculation, it being impracticable to examine the bone marrow before the experiment.

Attempts to transmit the infection to the pigeon by intravenous inoculation as a rule failed.

The author has been unable to cultivate the parasite on simplified Novy medium or in the peritoneal cavity of the white mouse.

The parasite appears to be distinct from *Toxoplasma cuniculi* and *Toxoplasma gondii* in that it is not inoculable either to the pigeon or to the mouse.

(521) Mesnil (F.) & Sarrailhé (A.). **Toxoplasmose Expérimentale de la Souris; Passage par les Muqueuses; Conservation du Virus dans le Cadavre.**—*Compt. Rend. Soc. Biol.* 1913. June 27. Vol. 74. No. 23. pp. 1325-1327.

Having shown in a preliminary experiment with *T. gondii* that the deposition of a drop of peritoneal exudate from an infected mouse on the conjunctiva and in the vagina of other mice caused

infection, the authors carried out a number of experiments on the same lines with the following results:—

Mucous membrane.	Results.		Average duration of infection.
	Positive.	Negative.	
Vagina	4	0	10 days.
Prepuce	0	2	—
Conjunctiva	1	0	13½ days.
Vagina and conjunctiva	2	0	10 days.
Mouth	2	1	14½ days.

Although positive results followed the placing of infective material on mucous membranes, it was found that infection would not take place through sound skin.

The duration of the disease was greater than that following intraperitoneal inoculation, and the dose administered did not appear to have much effect upon the result obtained. In every case the resulting infection was a generalised one. It is remarkable that parasites were numerously present in the thymus, and that the lymphatic glands were enlarged and contained parasites. The organisms were also present in the thyroid and parotid glands, in addition to the usual viscera.

It was found that the peritoneal fluid of a mouse which was kept in the laboratory remained virulent for 18 hours after death, and in one instance it remained infective for 30 hours.

(522) Laveran (A.) & Marullaz (M.). **Recherches Expérimentales sur le** *Toxoplasma gondii.—Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. pp. 460-468.

Mice inoculated intraperitoneally die in about five days, and it is easy to keep a strain running by subinoculations with peritoneal exudate every three days. The parasites are more numerous when the exudate is small in amount and viscous than when it is clear and serous.

There is enlargement of the spleen and congestion of the lungs. The parasite may be found in the liver and spleen, lungs, and, in some cases, in the bone marrow.

Grey mice and field mice can also be infected.

The authors failed to infect white rats either by intravenous or intraperitoneal inoculation, this result agreeing with that obtained by Nicolle and Conor. A dormouse also failed to become infected as a result of intraperitoneal inoculation.

Rabbits can be infected either by subcutaneous, intravenous, or intraperitoneal inoculation. Three out of six rabbits inoculated into the peritoneum failed to become infected, and they resisted subsequent inoculations by the subcutaneous, intraperitoneal, and intravenous paths.

In the rabbit there is always wasting, and there is as a rule an abundant peritoneal exudate which is poor in parasites. The naked-eye appearance of the liver and the histology of the alterations produced are identical with those produced by *T. cuniculi.*

Parasites are generally numerous in smears from the congested portions of the lungs, but rare in the bone marrow.

Three young guinea-pigs were successfully infected by intraperitoneal inoculation from a mouse, and died in about 4 days. In addition to these animals the authors have succeeded in infecting the mole, hedgehog, shrewmouse, dog, pigeon and *Padda oryzivora*. They failed to set up infection in the rat, dormouse, fowl, several exotic passerines, frogs, and lizards.

The results of the experiments detailed in this paper confirm the opinion previously expressed by the authors that *T. gondii* and *T. cuniculi* are identical. The two organisms possess the peculiar characteristic of being inoculable to both birds and mammals, and yet the rat is refractory while the mouse is susceptible.

Mesnil states that the rat is refractory to intravenous inoculation, but that he has succeeded in inoculating a young dog intravenously. The authors have also discovered that *Toxoplasma gondii* is capable of penetrating healthy mucous membranes, particularly that of the vagina. It is capable of setting up a very severe inflammation in the vaginal mucous membrane in the mouse, and causing the production of a cellular and viscous exudate which contains numbers of living virulent toxoplasms.

523) Nicolle (C.) & Conor (Marthe). **La Toxoplasma du Gondi. Memoire Complet.** — *Arch. Inst. Pasteur Tunis.* 1913. No. 1-2. pp. 106-115.

Natural infection in the gondi.—As a rule no symptoms are observed save during the few hours before death. The animal is generally fat. There is a clear exudate in both pleural cavities, associated with congestion or hepatisation of the lungs. The spleen may be greatly enlarged, and, less constantly, there is slight enlargement of the liver. In rare cases there are no visceral lesions.

The distribution of the parasite.—The spleen as a rule contains immense numbers of the organism. Next in order stand the liver and the lungs. Parasites are rarely encountered in the kidneys and seldom or never in the blood or bone marrow.

The parasite varies in shape, being curved, pear-shaped, oval or round. The measurements vary from 2·5 to 6 microns in length by 2 to 3 in width. There is a single nucleus which is usually centrally placed. If it be not central that extremity of the parasite towards which it is displaced appears swollen, the opposite end being attenuated.

The parasite may occur free or enclosed in cells. These are generally mononuclear leucocytes, but they may be found in polynuclears.

Multiplication takes place so far as is known by longitudinal division only, and any number of daughter organisms up to 20 or 30 may be formed. These generally cling together forming a rounded mass and suggesting encystment, but no true encystment has been observed.

Experimental infection.—The infection has been transmitted to healthy gondis by intraperitoneal inoculation with bone marrow

from a naturally infected gondi, the material used being very poor in parasites.

Next to the gondi, the mouse is the most susceptible animal. Death after intraperitoneal inoculation generally occurs in 5 or 6 days. As a rule there is no generalised infection, but a local multiplication of the organism with the passage of a few parasites into the liver and spleen. At the post-mortem there is found an abundant greyish mucoid exudate in the peritoneal cavity, and the viscera are covered with a delicate false membrane. The parasite is encountered in large numbers in this exudate, enclosed in cells, and it is also found in the endothelial cells of the peritoneal membrane. Parasites are very scanty in the spleen, exceptionally present in the liver, and absent from the blood and bone marrow. In a few cases the infection has been successfully transmitted by intramuscular inoculation.

The guinea-pig is less certainly infected than the mouse by intraperitoneal inoculation, but when infection occurs the course of the disease and the lesions produced closely resemble those found in the mouse.

The pigeon is susceptible, but not so certainly as the mouse. The course of the infection is slower in the pigeon than in the mouse, and there is a tendency to generalisation. The sole method of infection which succeeds is intraperitoneal inoculation. Death takes place in from 9 to 30 days, and the most marked symptom is excessive loss of weight.

At the post-mortem there may or may not be found false membranes. The liver is enlarged and very friable. There is no enlargement of the spleen, but the pulp is very soft. The liver is found to contain the largest number of parasites, and after that the spleen, lungs and bone marrow. Parasites may be fairly numerous in the blood and kidneys. The parasite is not found in the false membranes except in those cases in which death takes place early.

Five attempts to infect young rabbits all failed, and entirely negative results have followed the inoculation of white rats, a young dog, two macaques, two toads, and two frogs.

The details of the experiments upon which the conclusions are based are given.

HORSE SICKNESS.

(524) Kuhn (P.). **Die Immunisierung von Pferden gegen Pferdesterbe mit Hilfe von erhitzten Virus.** [The Immunisation of Horses against Horse Sickness with Heated Virus.]—*Zeitschr. f. Immunitätsforsch. u. exp. Therap.* 1 Teil. Orig. 1913. July 26. Vol. 18. No. 6. pp. 591-615.

In this paper the author records in detail the results of 25 experiments in which attempts were made to immunise horses against horse sickness by means of infective blood heated to 60° C. for varying periods. In some instances the virus was subjected to heat once only, but in other cases the heating was repeated a number of times. Other variable factors in the

experiments were, the dose used and the manner in which the material was administered. The virus used was either pericardial fluid or oedematous liquid from the lung.

In the first experiment 10 cc. of oedematous fluid from the lung was heated for two hours on three occasions and injected subcutaneously. The period of incubation was nine days and death took place on the fourteenth day.

An animal which was injected with 10 cc. of virus which had been heated 5 times for 2 hours and 20 minutes each failed to shew any symptoms, but when the animal was inoculated on the 26th day with 10 cc. of virus which had been heated three times only symptoms appeared and death occurred on the ninth day.

In a large number of the experiments the virus was heated to 60° C. for 2 hours and 20 minutes on four occasions, and of this material doses varying from 5 to 50 cc. were given, the dose being repeated on from 2 to 7 consecutive days.

It would appear from the table given that in eight or nine cases the heated virus was responsible for the death of the animals from horse sickness. In three or four cases the animals did not react in any way to the heated virus, but their immunity does not appear to have been tested with unheated virus. In 5 instances animals which received two or three doses of heated virus—generally one dose of about 5 cc. and one of about 40 cc. at an interval of a couple of days—resisted inoculation with 0·1 to 0·3 cc. of unheated virus. In the great majority of these cases the inoculations were intravenous. The author's conclusions are as follows:—

1. Inoculation with the virus of horse sickness frequently sets up reactions the cause of which has not yet been explained.

2. When oedematous fluid from the lung taken from a horse dead of horse sickness is heated to 60° C. the duration of the heating influences its virulence as indicated by a prolongation of the period of incubation.

3. The period of incubation may be as long as 45 days. Consequently in experiments with horse sickness a period of 45 days must be allowed to elapse before an animal is used for a new experiment.

4. When the virus is heated to 60° C. on four consecutive days the inoculation of 5 to 10 cc. subcutaneously in some instances causes death from horse sickness, but in other cases produces no illness.

5. When intravenous inoculations of virus treated in this way are given repeatedly at intervals of a few days, and to the total quantity of about 30 to 40 cc., a marked degree of immunity is established, and this by the 14th day after the first inoculation. Further experiments are required to ascertain the practical value of the method.

HELMINTHS.

(525) Seurat (L. G.). **Sur deux Spiroptères de Chat Ganté** (*Felis ocreata* **Gmel.**)—*Compt. Rend. Soc. Biol.* 1913. April 11. Vol. 74. No. 12. pp. 676-679. With 7 figures.

Spiroptera subaequalis Molin. This worm inhabits tumours in the pyloric portion of the stomach. It is distinguishable from *Spirocerca sanguinolenta* of the dog by its smaller size (20 mm.) the conformation of the teeth in the oral cavity, the ovijector, and the much smaller size of the tail in the female.

The mouth is limited by a rim which is slightly indented at six places and it opens into a large buccal cavity attached to the walls of which are six very prominent teeth.

The ovijector resembles that seen in the spiroptera of the dog. It shows a pyriform vestibule with a long neck in which the sphincter projects obliquely, but while in the parasite of the dog the vestibule is lined with a thin chitinous layer and is packed with eggs, that found in *Spiroptera subaequalis* is far more narrow and is lined by a very thick chitinous membrane. The eggs seldom number more than two or three.

The worm is red in colour. There are two lateral papillae situated just behind the nerve ring. The excretory pore is ventral and below the papillae. There are no alae.

The oesophagus measures one quarter of the total length in the male and one-third in the female.

The female is from 19 to 21 mm. in length. The tail is short and obtuse. The vulva is not prominent and is situated 5 mm. from the cephalic extremity.

The male is a little larger than the female. The lateral wings of the caudal pouch are supported by four pairs of pre-anal rays and two pairs of post-anal rays. There is a single ray in front of the cloaca, and a group of eight small papillae which are difficult to see at the caudal extremity. The spicules are very unequal in length, measuring 2·25 mm. and 470 microns. There is one accessory piece.

The second spiroptera belongs to the genus Habronema, is of a red colour, but is found free in the stomach.

There are two very large alae which arise just in front of the nerve ring and extend for two-thirds of the length of the body. There are two cervical papillae. That on the left is situated in front of corresponding ala, and that on the right behind the nerve ring on the ala. [From an examination of the diagram given it would appear that these terms have been transposed.]

The mouth is surrounded by two lips which are markedly indented on their free border. The lips each show three teeth, the middle one of which is the largest and extends the whole length of the buccal cavity. There are also a dorsal and a ventral tooth which extend the whole length of the cavity, and, when viewed from in front, the mouth appears to be surrounded by eight teeth.

The oesophagus is divisible into three parts: an anterior portion where the muscular tissue is very strongly developed, a middle portion which is surrounded by the nerve ring, and a posterior glandular portion.

The female measures 8·5 to 9 mm. The excretory pore is 210 microns from the anterior extremity. The tail is regularly attenuated. The vulva is slightly salient and is situated just posterior to the middle of the body. The eggs show a little projection at one pole. The parasite is ovo-viviparous.

The male measures from 3·5 to 5·5 mm. The cloaca which opens between two prominent lips is placed 180 microns from the caudal extremity. There are four pairs of pre-anal papillae which are grouped in pairs, and two pairs of post-anal papillae.

The right spicule measures 280 microns, and the left 480 microns. There is one accessory piece.

(526) Railliet (A.) & Henry (A.). **Un Haemostrongylus des Bronches du Léopard.**—*Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. pp. 451-454. With 2 text-figures.

The parasite described in this paper was found in the bronchi of a leopard killed at Dongou in the Belgian Congo.

The body of the worm is of a greyish colour and tapers slightly at both ends. The alimentary tract is of a darker tint and is entwined with the genital organs. The cuticle is striated longitudinally, and in the female there are at places delicate transverse folds.

The mouth is surrounded by six small papillae. The oesophagus is only slightly dilated at the posterior part and measures from 290 to 335 microns in length. The nerve collar and excretory pore are situated a little in front of the middle point of the oesophagus.

The male is from 10·5 to 12·4 mm. in length, and from 260 to 290 microns in thickness. The posterior rays of the caudal pouch are very short and are inserted into a wide main trunk. The middle and anterior rays are cleft. There are two long slender spicules which are striated transversely. There is no accessory piece.

The female measures from 20 to 23 mm. in length and from 460 to 525 microns in width. The tail which is bluntly conical has, at a point 35 to 45 microns from its extremity, two small lateral papillae. The anus opens 190 to 250 microns from the posterior extremity, and the vulva a little posterior to the middle point of the body. The uterus contains eggs in all stages of development. Eggs containing embryos measure about 80 microns in length by 50 in breadth. The embryos have a small projecting ventral lip at the anterior extremity, and a flexuous appendage at the caudal extremity. They measure from 250 to 270 microns in length and 12 to 15 in thickness.

The parasite is viviparous.

The authors conclude that the parasite belongs to the family *Strongylidae* and to the sub-family *Metastrongylinae*. The worms differ in characters of secondary importance only from *Haemostrongylus vasorum*, the parasite of the right heart and pulmonary artery of the dog.

On this account, and in spite of the fact that the habitat of the organism is the bronchial tubes, the authors propose to place it in the genus Haemostrongylus and call it *H. subcrenatus* in reference to the transverse folds in the cuticle.

MISCELLANEOUS.

(527) Moldovan (J.). **Sur le Développement du *Leucocytozoon ziemanni* (Laveran). Note préliminaire.**—*Bull. Soc. Path. Exot.* 1913. June. Vol. 6. No. 6. pp. 428-429.

In two owls which died natural deaths the author has discovered organisms belonging to the asexual cycle of this parasite. The birds were at the same time hosts of *Halteridium noctuae*.

The preparations were made from the lungs, heart, brain, liver, kidneys, and bone marrow. In addition to the typical gametes there were found organisms included within lymphocytes and erythroblasts, which from their characters must be considered as young schizonts of the leucocytozoon. In some of the preparations, particularly those from the lungs and the brain, all stages of schizogony were found from the young schizonts up to those in which there were thirty nuclei or more.

In a general way the young parasites resembled those described by KEYSSELITZ and MAYER in the leucocytozoon of *Guttera pucherani*, and by von PROWAZEK in Sumatra fowls.

In some of the young parasites there was enlargement without division of the nucleus, and these shewed differentiations of their nuclei and cytoplasm suggesting phases in the development of gametes. Some forms were observed suggesting the stages of the development of the typical fusiform gametes.

The author states that in the same smears there were trypanosomes which were well differentiated into the male and female forms corresponding to the motile stages in the evolution of the gametes as described by SCHAUDINN.

It is said that the objection that might be raised that the forms observed were in reality stages in the development of *H. noctuae* cannot be upheld when the form and structure of the invaded cells and the resemblance shewn to the forms described by KEYSSLITZ, MAYER, and von PROWAZEK are taken into consideration.

The schizogony is said not to correspond with that described by FANTHAM for *Leucocytozoon lovati*.

(528) LEGER (A.). **Parasite des Hématies, Genre *Grahamella* (Brumpt), de *Mus maurus* (Gray).** [A Parasite of the Genus *Grahamella* (Brumpt) in the Blood Corpuscles of *Mus maurus* (Gray).]—*Bull. Soc. Path. Exot.* 1913. April. Vol. 6. No. 4. pp. 247-249.

The author has found in the blood of *Mus maurus* at Bamako the rod-like organisms previously described by a number of authors as occurring in the blood of different animals, including the mole, gerbil, dormouse, and field-mouse. The organisms were found in 28 out of 125 rats examined.

There is not any distortion of the invaded corpuscles, and the number of organisms found in a single cell may vary from 6 to 80, but as a rule there are from 30 upwards. Invaded corpuscles are generally scanty in the blood taken from the tail, but more numerous in the heart blood. The organisms measure 1 micron in length, by 0·25 micron in width.

Good results may be obtained by staining with a mixture of Giemsa and acetone in equal parts, Giemsa (1 to 10) for fifteen minutes with slight differentiation with absolute alcohol, and with thionine-picric acid method devised by Sabrazès.

Under a high magnification some of the organisms appear to be attenuated in the middle as if in a state of transverse division. Rats, guinea-pigs, and rabbits have been inoculated in various ways without success.

(529) Archibald (R. G.). **Aspergilliosis in the Sudan Ostrich.**—*Jl. Comp. Path. & Therapeut.* 1913. June. Vol. 26. No. 2. pp. 171-173. With 3 text-figures.

The lesions described in this paper were encountered in an ostrich in western Kordofan which had died with signs of marked emaciation. The disease principally involved the bronchioles. The upper portion of the bronchus was lined with dark granular masses projecting into the lumen. These masses were somewhat friable, but closely adherent to the wall. On the surface of the bronchiole adjacent to the lung tissue there were several "plaques" varying in size from a millet seed to a pea. The majority of them were discrete, but a few had coalesced. Their surface was marked with ridges and depressions.

In sections of the dark granular masses stained with Gram numerous filaments and conidia were found. Some of the filaments measured 6 microns in width and possessed very thick walls. Their extremities were dilated into club-shaped bodies measuring 18 microns in diameter, and upon these were arranged in radial fashion numerous sterigmata cells. At the distal end of each sterigmata cell were found numerous conidia measuring 2 to 3 microns, and there were large numbers of free conidia. Some of these cells had clear contents, others presented a dark-stained area in their centre, while others were filled with a mass of substance which stained densely with iron haematoxylin. The branching of the filaments was irregular, and some shewed very definite segmentation.

The "plaques" consisted for the most part of dense fibrous tissue with granular amorphous areas devoid of cellular elements. Scattered through the "plaques" were filaments 4 microns in breadth, which offered considerable resistance to staining.

Cultivation experiments with the object of ascertaining the species of the parasite could not be undertaken, but morphologically it was not unlike *Aspergillus fumigatus*.

(530) Knowles (R.) & Acton (H. W.). **A Note on Kurloff Bodies.**—*Indian Jl. Med. Research.* 1913. July. Vol. 1. No. 1. pp. 206-211. With 2 plates.

The authors have made series of blood films from a single guinea-pig, and have fixed and stained them in various ways, comparing the pictures obtained by the different methods.

Films were fixed in the following manners:—

1. air dry and fixed with methyl alcohol;
2. fixed while wet with methyl alcohol;
3. fixed while wet with formol-alcohol (formalin 1: absolute alcohol 9);
4. fixed while wet with Schaudinn's granule fixative (saturated aqueous perchloride 60 cc., absolute alcohol 30 cc., glacial acetic acid 3 cc.);
5. fixed while wet by plunging immediately into Schaudinn's fixative, kept at 60° C. on a water bath (saturated solution of perchloride in saline 2 parts: absolute alcohol 1 part).

Some of each of these were stained with Leishman's stain, Giemsa's stain, the original Romanowsky, and Mallory's iron-haematoxylin with watery eosin as a counter stain.

They have also made examinations by Ross's jelly method, the preparations being examined at room temperature, after incubation at 37° C. for one hour, and on a warm stage at 40° C.

Preparations have been examined under dark ground illumination and with vital staining with dahlia.

Their conclusions are as follows:—

"1. No reliance can be placed upon the appearance of the Kurloff bodies as seen in fixed films, unless the action of the fixative fluids has been previously investigated in order to see what fixation images are obtained. Otherwise the different fixation images obtained may be readily mistaken for stages in a cycle of development.

"2. In Kurloff bodies stained by a dahlia solution and examined on a warm stage we have been unable to trace any cycle of development.

"3. It seems somewhat unlikely—though not impossible—that a structure seen in the blood of 71 per cent. of apparently perfectly healthy guinea-pigs is parasitic in origin.

"4. We adhere to the view that they are cell inclusions of a non-parasitic nature.

"5. We believe that the Kurloff body is a vesicular structure, and probably of cytoplasmic origin. The guinea-pig is an animal in which these cytoplasmic structures are particularly well developed, *e.g.*, the large archoplasmic vesicles in the testicular cells.

"6. In the course of the repeated examinations of the blood of pigeons in connection with the study of the Halteridium parasite we have occasionally seen somewhat similar bodies in the large mononuclear leucocytes and we doubt if the Kurloff body is specific for the guinea-pig."

(531) Bouilliez (M.). **Nouvelles Recherches Expérimentales sur un Plasmodium des Singes.**—*Compt. Rend. Soc. Biol.* 1913. May 23. Vol. 74. No. 18. pp. 1070-1072.

The author has succeeded in inoculating the following monkeys with *Plasmodium inui*:—*Macacus nemestrinus*, *Cercopithecus cephus*, and *Cercopithecus callitrichus*. In the case of the first two the infection took a chronic course, but in the case of the last death occurred with haemoglobinuria on the twelfth day after inoculation. A male and female chimpanzee failed to become infected.

In two instances splenectomy was performed after the second appearance of the parasites in the blood. In one case the animal died as a result of peritonitis and in the other case the effect of the operation appeared to be to lengthen the period for which the parasites were present in the blood, but the animal died.

The results obtained in two experiments indicated that quinine is valuable as a preventive, but experiments designed to ascertain the curative value of the drug did not allow any definite conclusions to be drawn.

Attempts to cultivate the parasite by Bass's method at 40° C. failed, but in tubes containing defibrinated blood and dextrose there appeared to be a multiplication of the parasites when the tubes were kept at about 22° C.

(532) Graybill (H. W.). **The Action of Arsenical Dips in protecting Cattle from Infestation with Ticks.**—*U.S. Dept. Agriculture. Bureau of Animal Industry. Bulletin* 167. 1913. April 15. pp. 27.

This bulletin contains details of a number of experiments carried out with the object of ascertaining the effects produced by oily substances upon ticks as well as experiments connected with arsenical dips. The following is the summary:—

"In this bulletin the factors entering into the efficacy of dips used against ticks are discussed. Dips act both in a direct destructive way and in a protective manner preventing infestation. The protective action of a dip may be in the nature of a destructive or of a repellant action. The influence of dips on oviposition and the viability of the eggs is a factor in efficacy.

"The ingredients of home-made arsenical dips and the known or probable functions of each ingredient are discussed.

"It is suggested herein that any protective action that the usual arsenical dips might have would be expected to be due to a toxic rather than to a repellant action. Watkins-Pitchford has shown that cattle dipped in arsenic are poisonous to ticks.

"Ticks are destroyed by dips either by suffocation or by poisoning, or by both means. Tests were conducted showing that ticks are suffocated by the closing of their respiratory openings (spiracles). It was found that practically all engorged females that had their spiracles closed with Canada balsam died. In other tests of the same sort, in which oils were used, Beaumont oil proved much less effective than Canada balsam, and cottonseed oil was practically without effect.

"Smearing the scutum and mouth parts of engorged females with oils and viscous substances had no influence on the mortality or oviposition, or on the per cent. of eggs hatching.

"In tests in which engorged females were dipped in Beaumont oil and in cottonseed oil the former proved very much more effective than the latter, and this is due in all probability to a toxic action. Beaumont oil had a marked influence on oviposition, on the number of eggs deposited, and on the viability of the eggs, whereas cottonseed oil has no effect.

"The possible avenues for the entrance of arsenic into the bodies of ticks are enumerated and the porose areas are pointed out as possible vulnerable points in the armour of the tick.

"Three cattle-dipping experiments were conducted with an arsenical dip containing 8 pounds of arsenic trioxide to 500 gallons of water, in order to test its protective action against tick infestation. Seed ticks were placed on the cattle at varying periods after they were dipped. In the first experiment the ticks were placed on the cattle at periods ranging from a few hours to four weeks, in the second from a few hours to two days, and in the third at five days after dipping. It was found that the dip rendered no protection when the exposure to infestation was five days or longer after dipping. The limit of protection ascertained in the experiments was two days. No tests were made covering the intervening period between two and five days.

"Arsenical poisoning which occurred among the animals in one experiment was apparently caused by undissolved arsenic in the dip. It would therefore seem that undissolved arsenic in a dip is highly dangerous.

"It is shown conclusively that the protective action of arsenic is dependent on its toxic action and not on a repellant action.

"As a result of incidental observations made on engorged female ticks from animals suffering from Texas fever it was found that the mortality of such ticks may be very high, as much as 95 per cent. The cause of this is not known. It may be nutritional in character, due to the change or impoverished condition of the blood absorbed, or it may be due to the parasitism of *Piroplasma bigeminum*, the micro-organism which is the direct cause of Texas fever.

"Observations made for the purpose of determining whether there was any relationship between the degree of infestation and the time elapsing

between the last dipping and the infestation, and also on the mortality of engorged females from dipped animals infested subsequently to dipping as compared with that of ticks from undipped animals were inconclusive. Oviposition and viability of the eggs of these ticks appeared to be unaffected."

Book Reviews.

(533) Besson (A.). **Practical Bacteriology, Microbiology and Serum Therapy (Medical and Veterinary). A Text Book for Laboratory Use.** (Translation from the 5th French edition by H. J. Hutchens.)—xxx. + 892 pp. With 416 illustrations. 1913. London: Longmans, Green and Co. [36*s.* net.]

The principal value of this book appears to lie in that portion of it which is devoted to laboratory technique, at least as far as the veterinary surgeon or student is concerned. The descriptions given of the organisms causing disease in the lower animals and of the diseases themselves are in some cases somewhat incomplete, and in some instances not quite accurate. In the description of the methods of infection in black quarter the following statements, which appear to be difficult to reconcile, occur within a few lines of each other: "The same dose of virus which will kill an ox when inoculated into the cellular tissues of the body will set up merely a benign infection if inoculated into the connective tissue of the neck," and "The inoculation of a virulent virus into the veins of an ox merely leads to a temporary rise of temperature; but if at the time of inoculation a trace of virus gains access to the perivascular tissues a fatal septicaemia ensues." Apart from the contradiction contained in these sentences it may be said that it is exceptional for the bacillus to multiply in the blood stream to such an extent as to warrant the term septicaemia being applied to the condition produced.

In connection with anthrax it may be noted that the bacillus is said to be capable of sporulating in a buried carcase, a view which has much to be said against it.

The pathogenic protozoa of the lower animals are very briefly dealt with and in some instances very important information is not given at all. For example, no mention is made regarding "blue bodies" in East Coast Fever. The error regarding the development of the sporoblasts in *Coccidium cuniculi* is perpetuated in that it is stated that the contents of the oocyst first divide into two and then into four sporoblasts, whereas the division into the four sporoblasts takes place simultaneously.

No mention is made of such important diseases as Johne's disease and contagious abortion.

For the most part the book is fully and excellently illustrated and the work of the translator and the publisher has been well done.

The scarcity of books dealing with the subjects of this volume makes the book a valuable addition to the literature devoted to them and it will on this account be welcomed by teachers and students.

(533a) Scott (W.). **Clinical Bacteriology and Vaccine Therapy for Veterinary Surgeons.** 1st Edition. xii. + 222 pp. With 12 plates and 37 text-figs.—1913. London: Baillière, Tindall & Cox. [7*s.* 6*d.* net.]

The numerous errors and mis-statements of fact contained in this volume indicate that the author's knowledge of his subject is very limited. The book also appears to have been hastily and carelessly put together, as in many instances sentences are so constructed as to convey a meaning quite different from what was obviously intended. For example, on page 140 the following sentence appears:—"An animal injected with an immune serum lasts from three to four weeks." Well known names such as Sclavo and Sobernheim are misspelled. An administration is said to be made "per oram." Such examples could be given in abundance.

The book cannot be recommended.

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